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ANNALS OF PHILOSOPHY;

OR, MAGAZINE OF

CHEMISTRY, MINERALOGY, MECHANICS,

NATURAL HISTORY,

AGRICULTURE, AND THE ARTS.

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ANNALS

OF

PHILOSOPHY.

JULY, 1818.

Article I.

History of physical Science from the Commencement of the Year 1817. *Part I.* By Thomas Thomson, M.D. F.R.S. &c. &c.[*]

CHEMISTRY.

THIS science has been, since our last historical sketch, advancing with its usual rapidity. And as the analytical methods have of late years been very much improved, and much more attention is at present paid to precision than was formerly the case, more confidence may be put in the researches of those chemists at least who have acquired the requisite skill. This is one among the many advantages which has resulted from the general diffusion and adoption of the atomic theory. I shall, as usual, arrange the different new facts under general heads, as such a distribution tends considerably to facilitate the recollection, while it enables the reader more readily to perceive which department of the science has been cultivated with the greatest industry and success.

I. LIGHT AND HEAT.

1. *Magnetizing Power of the Violet Rays of the solar Spectrum.*—Our readers will probably recollect that M. Mori-

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[*] The change that took place in the Editorship of the *Annals of Philosophy* at the close of the last year, and the engagements of Dr. Thomson during the winter and spring, in his new situation at Glasgow, necessarily interrupted the plan that had been before adopted, of appropriating a part of the January number to an account of the progress of science for the preceding year. The history of chemistry has now been completed by Dr. Thomson, and is here presented to our readers; the account of the progress of the other departments of physical science will be given in a subsequent number.

chini of Rome announced, some years ago, that when the violet rays from a prism are drawn along a steel wire for some time always in the same direction, the wire acquires the properties of a magnet. This experiment has been frequently repeated by other persons, but the result has been generally unsuccessful, or at least equivocal. Hence the general opinion at present entertained is, that Morichini has, somehow or other, deceived himself. M. Ridolfi, however, has published a set of experiments on this curious subject in the Journal of Brugnatelli These experiments, if we admit their accuracy, demonstrate the truth of Morichini's statement, and even account for the failure of those who have turned their researches to this subject. Ridolfi made a needle magnetic in 47′ by making the violet ray pass continually from the eye to the point. When this needle was suspended, the point always turned towards the north. By making the violet ray pass for 47′, over the same needle in the opposite direction, or from the *point* to the *eye*, the magnetism was entirely removed. In ten minutes more it acquired the opposite magnetism. The violet ray made to pass for an hour over a weak magnet in the direction opposite to that in which it had received its magnetism, destroyed its magnetic energy altogether.

According to Ridolfi, the violet ray is incapable of converting a needle into a magnet when the air is moist. This he considers as the reason why so many have been unable to verify the experiment. He even relates a variety of very curious trials which he made on the effect of moisture in this respect. These experiments constitute the most curious part of the memoir. But they would require to be successfully repeated by others before we could give their accuracy implicit credit. They seem to point out a new analogy between magnetism and electricity.*

2. Next to the mathematical theory of heat, published at Paris in a quarto volume by M. Fourier,† the most important addition to this intricate, but essential department of chemistry, is the *Recherches sur la Mesure des Temperatures et sur les Lois de la Communication de la Chaleur*, by MM. Dulong and Petit, which gained the physical prize voted by the French Academy of Sciences on March 16, 1818. Mr. Dalton, in the first part of his System of Chemistry, had given it as his opinion that bodies expand as the square of the temperature, reckoning from the point of their maximum density. This opinion induced him to propose a new thermometrical scale, which he considered as correct, and as removing the ambiguities and apparent anomalies which have hitherto perplexed the investigations of those who

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* The experiment has been lately performed with success by M. Carpe, at Geneva, in the presence of Prof. Playfair.—See *Annals of Philosophy* for May, 1818.—ED.

† This work is the result of a long continued investigation, and is highly worthy of the attention of chemists.

attempted to determine the expansibility of bodies by heat. The object of the important experiments of Dulong and Petit was to determine with as much precision as possible the rate of the expansion of different bodies, in order to ascertain how far the peculiar opinions of Mr. Dalton are well founded: the analysis of this paper will be given in a subsequent number.

3. Sir Humphry Davy's researches on flame are distinguished by that analytical skill and that inventive genius which so eminently characterize the investigations of this sagacious philosopher, to whom chemistry lies under so many and so important obligations. These researches have been detailed at such length in the preceding volumes of the *Annals of Philosophy*, that it is unnecessary to enter here into minute details. Flame he conceives to be aerial matter heated so high as to be luminous. And it would appear that different temperatures are necessary to maintain the combustion of different gaseous bodies. When we cool them below that temperature, they can burn no longer, and of course are extinguished. Hence the reason why a covering of wire gauze prevents a lamp from exploding the carbureted hydrogen gas in coal mines, even when it is mixed with such a proportion of common air as to be at the exploding point. The heat is so much diminished by the wire, that the aerial matter which passes through is too cold to be capable of setting fire to the coal gas. When a hot platinum wire of a small diameter is put into an exploding mixture of a combustible gas, it becomes red hot, and continues luminous for a long time, a combustion of the gas going on around the wire, evolving sufficient heat to maintain the luminous temperature of the wire; but insufficient to explode the gaseous mixture. This very curious and important fact has been applied to the maintaining what is called a lamp without flame. A few coils of platinum wire, about $\frac{1}{100}$th of an inch in diameter, are placed around the wick of a spirit lamp. The lamp after burning a short time is blown out, and the platinum wire becomes luminous, and continues so till the whole of the alcohol in the lamp is consumed.* Platinum has the smallest specific heat, and is the worst conductor of heat of any of the metals that can be drawn out into wire. Hence probably the reason why it is the only metal that answers for these experiments. Platinum possesses also another property which seems to be peculiar to it. Its specific heat is not sensibly increased by elevating its temperature. At least Dulong and Petit found that the specific heat of platinum, raised to the temperature of 572°, was no greater than that of platinum simply heated to 212°.

4. *Animal Heat.*—The curious experiments of Mr. Brodie upon rabbits will be recollected by all our readers. He decapitated these animals, but kept up their respiration by artificial means. The air underwent the usual changes, but the tempera-

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* *Annals of Philosophy*, xi. 217, 304, 306, and 437.

ture of the animals diminished more rapidly than would have been the case if the respiration had not been kept up at all. From these experiments Mr. Brodie concluded that the heat of animals is not kept up by respiration, but by the energy of the brain and nerves. M. Legallois has made a set of experiments to elucidate this difficult and obscure subject. We conceive it by no means an easy task to make experiments upon living animals from which satisfactory conclusions can be drawn respecting their functions, because they possess the power of accommodating themselves to circumstances. Thus when we put an animal into a close vessel, and oblige him to breathe the same air over and over again, there is reason to believe that the same changes are not produced upon the air that would be produced if the animal were in his usual circumstances, and obliged to draw the same portion of air only once into the lungs. We need not be surprised, therefore, that M. Legallois, notwithstanding all the pains which he took, has not succeeded in throwing much light upon the source of animal heat.

He observes that when the respiration of a decapitated animal is artificially kept up, the arterial blood is not converted into venous blood during the circulation; for the colour of the blood in the vena cava is precisely that of arterial blood. This observation will help us to account for the more rapid cooling of the decapitated animals in Mr. Brodie's experiments; for as the specific heat of arterial blood is greater than that of venous blood, it is obvious that if the change into venous blood does not take place, the waste of heat must be greater than in ordinary cases.

M. Legallois found that when the respiration of animals is constrained, by tying them down upon their back their temperature diminishes considerably; so much so, indeed, that if kept a sufficient time in that position, they die of cold. On making comparative experiments on the respiration of rabbits unconstrained, and fixed down upon their backs, he found that at the temperature of about 50° the quantity of oxygen consumed by them, while fixed upon their back, was considerably less than when breathing at liberty. But when the temperature of the atmosphere was about 70°, no such difference could be observed; or it was very trifling. The smaller the quantity of oxygen contained originally in the air which these animals were obliged to breathe, the greater was the diminution of temperature which they sustained. When atmospheric air was rarified, and brought to its natural density by a mixture of carbonic acid, the loss of heat which animals breathing such a mixture sustained, was the greatest possible. Yet the quantity of carbonic acid gas in the air did not increase, but rather diminished; so that it must have been absorbed by the animal. Thus the temperature of a dog obliged to breathe such an atmosphere for three hours sunk 25°, or was reduced from 102° to 78°. The temperature of a cat, in the same circumstances, was reduced from 104° to 81·5°, or 22½°.

When azotic gas is mixed with rarified air instead of carbonic acid gas, the diminution of heat which the animal undergoes is still considerable, though much less than in the former case. It is least of all when the animal is made to respire rarified air.

The temperature of the animal was determined in these cases by introducing the bulb of a thermometer into a small orifice cut in the skin of the breast. In all probability this diminution of heat was only superficial. We can hardly conceive the possibility of the temperature of the heart and blood being reduced 25° without destroying the life of the animal. M. Legallois observed that dogs and cats consume a much greater proportion of oxygen, compared to their weight, than rabbits. It would throw considerable light on this obscure subject if it could be determined whether the waste of animal heat in the first of these animals be greater than in rabbits. This is an investigation which M. Legallois proposed to undertake.—(Ann. de Chim. et Phys. iv. 1, 113.)

5. *Hydrogen Gas Lamp.*—M. Gay-Lussac, who has a particular genius for contriving simple and useful pieces of apparatus, has suggested a little instrument which may be useful in laboratories, either as a lamp or as a reservoir, to supply small quantities of hydrogen gas for the purposes of experiment. It consists of a Woulfe's bottle with three mouths. Into the central mouth is luted a glass tube open below and sinking nearly to the bottom of the bottle; the upper part of this tube, or the outside of the bottle, is blown into a ball of a capacity which ought not to be less than that of the bottle, and there is a small hole in the upper part of this ball so as to admit freely the atmospheric air; to another of the mouths of the Woulfe's bottle is ground a glass stopper so as to be perfectly air-tight, and to the extremity of the stopper is attached a cylinder of zinc, which may sink about two thirds of the length of the bottle; to the third mouth of the Woulfe's bottle is luted a glass tube, which may be fitted with a stop-cock, and turned conveniently for burning as a lamp, or for supplying hydrogen gas. The bottle is to be filled with dilute sulphuric acid, and the glass tube and ball, the stopper with the zinc cylinder, are to be fixed in their places. The acid will immediately begin to act on the zinc, and to generate hydrogen gas. This gas will accumulate in the upper part of the bottle, and by its elasticity will force the diluted acid into the glass ball till the surface of the liquid in the bottle gets below the cylinder of zinc: the formation of gas will then stop. When the stop-cock is opened, the weight of the liquid in the ball will force the hydrogen gas to issue through the tube; and it may be either set on fire and burned as a lamp, or collected in a pneumatic trough for the purposes of experiment. When the gas is sufficiently wasted, the sulphuric acid descends into the bottle, and gradually rises till it comes in contact with the zinc: new

hydrogen gas is evolved, and this continues till the whole of the zinc is dissolved.—(Ann. de Chim. et Phys. v. 301.)

6. *Metallic Thermometer.*—One of the most beautiful and convenient little instruments for which we are indebted to the modern improvements in chemistry, is a thermometer of metal contrived by M. Bréguet. It consists of slips of two metals unequally expanded by heat twisted into a spiral: to the extremity of the spiral is fixed an index, which moves round a graduated circle pointing out the temperature. It is obvious that when the spiral is heated, the index will move in one direction, and in another when the spiral is cooled, because it will twist or untwist itself according to the changes of temperature to which it is subjected. The two metals employed are silver and platinum; and in order to render the extreme points more fixed, and to prevent sudden starts, a slip of gold, the expansibility of which is intermediate between that of silver and platinum, is soldered between these two metals. This thermometer is more delicate than any mercurial thermometer whatever. It is even more delicate than an air thermometer. This spiral thermometer and a mercurial one were placed together under the receiver of an air-pump. The temperature at the time of the experiment was 66·2°. The mercurial thermometer when the air was pumped out sunk 3·6°; but the spiral thermometer fell 41·4°, or it fell down to 24·8° Fahrenheit.—(Ann. de Chim. et Phys. v. 312.)

II. ATOMIC THEORY.

Accurate chemical experimenting can scarcely be dated further back than the introduction of the atomic theory into chemistry. So short a space of time has elapsed since that introduction, and the number of substances to be examined is so great, that it is rather surprising that so considerable progress has been made in the determination of the weight of the atoms of bodies. By far the greatest share of this Herculean task has fallen to the lot of Berzelius; and whether we consider the accuracy or the indefatigable activity of this incomparable chemist, it could not have fallen into better hands.

From the extreme difficulty of performing chemical experiments with perfect accuracy, it becomes an object of great importance to repeat them very often. The only way by which minute accuracy can be introduced into chemical numbers, is by following the plan which has been so long customary with astronomers. They make a great number of observations with all the requisite care; and by taking the mean of the whole, the error is reduced to a very small quantity; and it obviously diminishes as the number of observations, the mean of which is taken, increases. Were the same method followed by chemical experimenters, their errors would diminish in the same way, and accurate numbers would be deduced from experiments conducted with but moderate precision. Thus though analysis may not enable us to determine the composition of sulphate of barytes with the utmost possible exactness; yet if we make 100 careful analyses, and take the mean of the whole, the probability is, that the numbers deduced from such a multitude of careful experiments would be almost absolutely correct.

The present state of the analyses on which the numbers pitched upon to represent the weight of the atoms of bodies depend, is such that every repetition of them demands to be carefully studied. On this account, a set of experiments, which Berzelius has lately published, consisting in a repetition of some of his early experiments on the subject, with every possible attention to accuracy, are particularly valuable. They afforded myself a great deal of gratification; for most of them approach very nearly indeed to the numbers which I have given in the last edition of my System of Chemistry. Of these, an abstract will be given in a subsequent number of the *Annals*.

2. *Relation between the Oxidation and the Specific Gravity of Metals.*—M. Frere de Montizon conceives that he has observed a simple relation between the specific gravity and the weight of the oxygen with which a metal unites. This oxygen, according to him, is either a multiple or submultiple of the density. The following table exhibits the evidence upon which this opinion is founded:

Oxides.	Analysers of the Oxides.	Quantity of Oxygen.			Sp. Gravity of the Metals.	Ascertainers of these Densities.
		Indicated by Analysis.	By Theory			
			in Formulas.	in Numbers.		
rotoxide of manganese.	Berzelius.	28·1050	4 D	28·000	7·0	Hijelm.
xide of zinc	Gay-Lussac.	24·41	3·5 D	25·01	7·1458	Gay-Lussac.
rotoxide of iron.	Berzelius.	29·5	4 D	30·4	7·6	Musschenbroek.
rotoxide of tin	Gay-Lussac.	13·6	2 D	14·0	7·0	Gilbert.
rotoxide of arsenic	Berzelius.	8·475	D	8·308	8·308	Bergman.
rotox. of molybdenum.	Richter.	8·6	D	8·6	8·6	Bucholz.
ungstic acid	Bucholz.	25·0000	1·5 D	25·83	17·22	Allen and Aikin.
eutoxide of antimony..	Thenard.	26·07	4 D	26·808	6·7021	Brisson.
eutoxide of cobalt	Proust.	25·5	3 D	25·615	8·5384	Tassaert.
rotoxide of uranium. ..	Berzelius.	9·4	D	9·0	9·0	Bucholz.
xide of bismuth.	Lagerhjelm.	11·275	$\frac{4}{3}$ D	11·622	8·7168	Musschenbroek.
eutoxide of copper....	Berzelius.	25·0000	3 D	25·752	8·584	Haüy.
xide of tellurium......	Berzelius.	24·83	4 D	24·46	6·115	Klaproth.
rotoxide of nickel.	Proust.	25·0000	3 D	25·14	8·380	Tupputi.
rotoxide of lead.	Berzelius.	7·73	$\frac{2}{3}$ D	7·568	11·3523	Brisson.
eutoxide of mercury. ..	Thenard.	8·0000	$\frac{D}{2}$	7·806	15·612	Biddle.
xide of silver.	Berzelius.	7·3985	$\frac{2}{3}$ D	7·394	11·091	Musschenbroek.
xide of palladium.	Vauquelin.	25·0000	2 D	24·0	12·0	Vauquelin.
Deutoxide of gold	Oberkampf.	9·820	$\frac{1}{2}$ D	9·820	19·640	Musschenbroek.
Deutoxide of platinum ..	Berzelius.	16·380	$\frac{4}{5}$ D	16·577	20·722	Klaproth.

(Ann. de Chim. et Phys. vii. 7

These data are scarcely sufficient to determine the point in question, as several of the numbers, both indicating the specific gravity and the proportion of oxygen, are unquestionably inaccurate. Were the law to hold good, it would indicate the existence of a certain relation between the density of the metals and the weight of their atoms—a relation which may possibly hold, though the present state of our knowledge does not enable us to perceive it. Such researches are, perhaps, rather premature. We ought in the first place to determine the composition of the metallic oxides with absolute precision. The relation between the oxides and the specific gravity, if any such exists, will then present itself to our view.

III. ANALYTICAL IMPROVEMENTS.

1. *On the Mode of separating Lime from Magnesia by the Bicarbonate of Potash.*—Bucholz dissolved equal weights of lime and magnesia in muriatic acid, and precipitated by adding a solution of bicarbonate of potash to the liquid. At first no precipitate whatever fell, or at least the precipitate was immediately redissolved by agitating the liquid. After a certain interval, a portion of the lime was separated in the state of carbonate; but he was unable, by this method, to separate the whole, or nearly the whole, of that earth. When the proportion of magnesia held in solution was small compared with that of the lime, in that case a much greater proportion of the lime was thrown down by the bicarbonate; but even in this case the whole of the lime was not thrown down. Bucholz concludes from these experiments that this method does not succeed, and that it ought not, therefore, to be practised.—(Schweigger's Journal, xvii. 56.)

According to Döbereiner, the best method of separating lime from magnesia is to employ the carbonate of ammonia. The lime in that case falls while the magnesia remains in solution forming a triple salt with the ammonia. The magnesia may be afterwards precipitated by boiling the liquid which contains it. —(Ibid. p. 78.)

2. *New Method of detecting Arsenic and Corrosive Sublimate.* —Brugnatelli has proposed the following method of detecting these poisonous substances. Take a quantity of fresh wheat starch, mix it with water, and add a sufficient quantity of iodine to give the liquid a lively blue colour. When an aqueous solution of white arsenic is let fall into this liquid, the blue colour disappears, and it becomes reddish. The same change is brought about by a solution of corrosive sublimate. A few drops of sulphuric acid will restore the blue colour, if it has been destroyed by arsenic; but it will not restore it if it has been destroyed by corrosive sublimate.—(Ann. de Chim. et Phys. iv. 334; and *Annals of Philosophy* for May, 1818.)

IV. GASEOUS BODIES.

1. *Escape of compressed Gases through capillary Tubes.*—It

would appear, from the experiments of Mr. Faraday, that the rapidity of the flow of gases in such circumstances diminishes as their specific gravity augments. Into a copper vessel, capable of holding 100 cubic inches, he compressed four atmospheres of the following gases, and then measured the time that elapsed during their issuing out through a thermometer tube, 20 inches in length, till the density was diminished to an atmosphere and a quarter. The time was measured by a seconds pendulum. The following table shows the number of seconds that elapsed during the flow of each gas:

Carbonic acid gas	156·5″
Olefiant gas	135·5
Carbonic oxide	133·0
Common air	128·0
Coal gas	100·0
Hydrogen	57·0

A wheel, carrying on its circumference a number of small vanes, was made to revolve with a given force in different gases. The time that the motion continued in the different gases is shown by the following table:

Carbonic acid gas	6″
Common air	8
Coal gas	10
Hydrogen	17

When gases are subjected to very small pressures, there does not appear to be any connexion between their specific gravities and the time which they take in flowing out through small tubes. Olefiant gas passes with as much facility as hydrogen, and twice as rapidly as carbonic oxide and common air. Carbonic acid escapes much more rapidly than gases inferior to it in density. Analogous results are obtained even under considerable pressures when the caliber of the tube is sufficiently diminished. The time of flowing out in such cases presents anomalies, probably owing to some loss of force in the tube; and it offers to mathematicians an interesting object of research. —(Royal Institution Journal, iii. 354.)

2. *Specific Gravity of the Gases.*—Professor Meinecke, of Halle, has published a table of the specific gravity of gases, drawn from a comparison of the various experiments hitherto made upon the subject; and, therefore, similar to the tables of Gay-Lussac and my own, formerly laid before the readers of the *Annals*. As this is a subject of first rate importance, and can only be brought to perfection by slow degrees, every additional fact relating to it deserves attention. I shall on that account transcribe Meinecke's table here. This document being almost entirely derived from other sources, which must be familiar to

the readers of the *Annals of Philosophy*, I consider it as unnecessary to state them here.

	Air being 1·000.	Hydrogen being 1·000.	Oxygen being 1·000.
Hydrogen.	0·0694	1	0·0625
Carbureted hydrogen	0·5555	8	0·5000
Ammonia	0·5901	8½	0·5312
Steam	0·6250	9	0·5625
Hydrocyanic acid vapour	0·9374	13½	0·8437
Carbonic oxide.	0·9722	14	0·8750
Olefiant gas	0·9722	14	0·8750
Azote.	0·9722	14	0·8750
Air.	1·000	14⅖	0·900
Deutoxide of azote	1·041	15	0·937
Oxygen.	1·111	16	1·000
Sulphureted hydrogen.	1·150	17	1·062
Muriatic acid	1·274	18½	1·156
Carbonic acid	1·527	22	1·375
Protoxide of azote	1·527	22	1·375
Vapour of alcohol	1·597	23	1·437
Cyanogen.	1·806	26	1·625
Chlorocyanic acid vapour.	2·153	31	1·937
Sulphurous acid	2·222	32	2·000
Chlorine	2·500	36	2·250
Vapour of ether	2·569	37	2·312
Nitrous acid	2·638	38	2·375
Sulphuret of carbon.	2·638	38	2·375
Phosgene gas	3·473	50	3·125

(Gilbert's Annalen der Physik, liv. 169.)

These specific gravities approach very nearly those which I have adopted in the last edition of my System of Chemistry. Hydrogen, and oxygen, and chlorine, are the very same that had been previously assigned by Dr. Prout. I have myself no doubt whatever of their accuracy; and suspect that Meinecke has been influenced by Dr. Prout's paper, though he has taken no notice of it. Meinecke adds some further reason for considering the specific gravity of hydrogen as only one sixteenth of that of oxygen. Dr. Prout's arguments are sufficiently strong to convince every person who will take the trouble to examine them, and is capable of understanding them. Some additional evidences are given in the paper at present before me. I may notice the specific gravity of steam, as determined by Gay-

Lussac, which is exactly the specific gravity of one volume of oxygen gas and two volumes of hydrogen gas reduced into 1½ volume; for

$$\begin{array}{lcrcl} \text{Oxygen} & = & & = & 1 \cdot 1111 \\ \text{Hydrogen} & = & \cdot 0694 \times 2 & = & 0 \cdot 1388 \\ \cline{5-5} & & & 2\,) & 1 \cdot 2499 \\ \cline{5-5} \text{Sp. gr. of steam} \ldots\ldots & & & = & 0 \cdot 6249 \end{array}$$

3. *Volta's Eudiometer.*—The little apparatus known by the name of Volta's eudiometer is indispensable in every laboratory. It is employed in burning mixtures of inflammable gases and oxygen gas by means of an electric spark, in order to determine the quantity of oxygen requisite to consume a given volume of the inflammable gas, and the nature and proportions of the products. The eudiometer universally employed by British chemists for this purpose, is the modification of Volta's eudiometer contrived by Mr. Pepys. It consists of a very thick glass cylindrical tube shut at one end, about eight inches long, half an inch in diameter, and graduated into inches, tenths, and hundredths. The upper extremity is pierced by two thick brass wires, terminating on the outside by rings, and on the inside by blunt ends. By means of these wires, the electrical spark destined to kindle the gas is passed. It is always left open below. All risk of any loss of gass is avoided, by making the quantity of gas consumed sufficiently small to prevent the expansion from driving out the whole of the water.

In France it is customary to shut the bottom of the tube by a stopper. This precaution, while it secures the experimenter against any escape of gas, exposes him to another source of error, perhaps still more dangerous than that which the stopper is intended to guard against. After the explosion, a portion of the gas is usually deprived of its elastic form. Hence a partial vacuum is formed in the eudiometer; and the water contained in the tube of course lets go the air with which it was previously impregnated. I have long suspected that the small quantities of azote which Theodore de Saussure met with in some of his analyses, might possibly have originated in some such way. Gay-Lussac has proposed a very simple and ingenious method of obviating this source of error. To the lower end of the eudiometer he fixes a conical valve, opening inwards. At the moment of the explosion, the valve is pressed down, and prevents any escape of gas. When the vacuum begins to be formed, the water, in which the eudiometer stands, forces up the valve, rushes in, and prevents a vacuum from being formed.—(Ann. de Chim. et Phys. iv. 188.)

4. Dr. Marshall Hall has contrived a very simple and ingenious instrument to save the practical chemist the trouble of reducing the volumes of the gases on which he is experimenting to

determinate weight and pressure, or rather to reduce these operations to a single question of the rule-of-three. We refer those who wish to provide themselves with such an instrument to the Royal Institution Journal, v. 52.

V. ACIDIFIABLE COMBUSTIBLES.

1. *Method of obtaining pure Hydrogen.*—Hydrogen gas is liable to be contaminated by certain impurities which exist in metals, usually employed in preparing it. Hence I conceive the reason why its specific gravity, as determined by direct experiment, has always been considerably above the truth. Mr. Donovan prepared hydrogen gas from zinc and iron, acted on by diluted sulphuric, and muriatic acid. By passing it through caustic ammonia, he obtained traces of sulphureted hydrogen, while lime water retained a small portion of sulphur. Hydrogen, purified in this way, had exactly the smell of phosphorus, and burned with a green flame. On the supposition that it might contain phosphorus, it was made to pass through four Woulfe's bottles. The first was filled with lime water, the second with nitrous acid, the third with water, and the fourth with a solution of sulphate of iron. Hydrogen gas, purified in this manner, had no smell whatever, and gave so little light when burning, that the colour of the flame could not be determined.—(Ann. de Chim. et Phys. ii. 375.)

2. *Sulphuret of Phosphorus.*—It is well known that when sulphur and phosphorus are heated together in a small glass tube, they unite and form a compound, which varies in its appearance according to the proportion of the two substances employed, and which decomposes water at the ordinary temperature of the atmosphere. Mr. Faraday found that when this compound is shaken with ammonia, and left for a few hours in that liquid, its impurities are removed, and a compound of a light yellow colour, semitransparent, and more fluid, is obtained. It may be kept in water without perceptibly acting on it. If sulphur and phosphorus be added alternately to a portion of it, any quantity of the two substances may be combined. A compound prepared in this way, and containing about five parts of sulphur to seven of phosphorus, did not become solid at 20°, and was very fluid at 32°. On remaining for some weeks in a bottle with water, it deposited crystals of pure sulphur, and a compound remained which was not so fusible as the former; but on remaining in an atmosphere of 38° or 40° for 12 or 14 hours, became a crystalline mass. This Mr. Faraday considers as a definite compound of sulphur and phosphorus. He attempted to analyse it, but did not succeed very well. His result was sulphur, 4; and phosphorus, 8. He considers this as nearly one atom sulphur and three atoms phosphorus; but the weight of an atom of phosphorus exceeds his estimate.—(Royal Institution Journal, iv. 361.)

3. *Charry Substance found in a Porcelain Furnace.*—This

substance was observed by M. Alluaud. It was black, had a certain metallic brilliancy, and was ramose. Gay-Lussac found it composed of pure carbon. The metallic carbon of Döbereiner, he found, left a residue of 25 per cent. of iron and silica. Hence it is obviously a carburet of iron and silicon.—(Ann. de Chim. et Phys. iv. 67.)

4. *Selenium.*—This is a new metallic substance, possessing several characters similar to those of sulphur, and others to those of tellurium; for the knowledge of which we are indebted to the sagacity and good fortune of Professor Berzelius.

This new substance, which unfortunately is very scarce, was discovered in the following manner. There is a manufacture of sulphuric acid at Fahlun in which the sulphur employed is extracted from the copper pyrites of that celebrated mine. Berzelius and Gahn lately purchased a share of this manufacture; and on examining the process, they were struck with a red matter which remained in the leaden chamber in which the sulphur was burned. When this substance was heated, it gave out a strong smell of horse-radish, which induced them at first to believe that it contained tellurium; but Berzelius took a quantity of it to Stockholm, and examined it more carefully. He succeeded in separating it from the sulphur with which it was combined, and ascertained that it possessed new and very peculiar properties. He gave it the name of *selenium*, from the analogy which it has to tellurium. Its properties, as far as they have been made known to us by Berzelius, are as follows:

Its colour is grey, with a strong metallic lustre; its fracture is vitreous, like that of sulphur, or like that of fahlore, of which it has the colour, though its lustre is much more considerable; its specific gravity is about 4·6; it is hard, but very easily frangible, like sulphur; when reduced to powder, it has a red colour, with here and there a metallic lustre, as is the case with the other brittle metals.

It softens at the temperature of boiling water, and melts when the heat is raised a little higher. During its cooling it preserves a kind of ductility, like sulphur or Spanish wax; so that it may be kneaded between the fingers and drawn out into fine threads which have a strong metallic lustre. When held between the eye and the light, these threads are transparent, and appear of a dark red colour. At a temperature nearly approaching the boiling point of mercury, selenium boils, and may be distilled over in opaque, metallic drops. The retort becomes filled with a yellow vapour, quite similar to that of sulphur; but not so intense. When distilled in a retort with a large neck, it sublimes in the form of flowers, of a fine cinnabar colour. These flowers are not in the state of oxide, and are converted into the usual greyish mass by simple fusion. When sublimed in the open air without taking fire, it evaporates in a white smoke, which is *destitute of smell*; but when held in the flame of a candle, or when heated before the blow-pipe, it tinges the flame of a fine azure blue, and gives out so strong a smell of horse-radish that the fiftieth part of a grain is sufficient to impregnate the air of a large chamber. Klaproth affirmed that tellurium gives out the same odour; but Berzelius could not obtain it either from pure tellurium, or from its oxide or its alloys. When he inclosed a little of it in a thin glass globule, and converted it into vapour by the blow-pipe till it forced its way through the globule, he observed the very same odour as that emitted by selenium.

Selenium combines with the metals, and the union is often accompanied by ignition. Selenuret of potassium has the metallic lustre and a greyish white colour. It dissolves rapidly in water without effervescence, communicating the colour of strong ale, and a taste quite the same as that of sulphuret of potash. The acids disengage from it a gas, having, when diluted, an odour quite similar to that of sulphureted hydrogen; but when introduced even in very small quantity into the nostrils it produces a very painful sensation, followed by inflammation, and the symptoms of catarrh. The effects produced by drawing into the nose a bubble of this gas, not exceeding the size of a pea, remained for several days; and the sensibility of the schneiderian membrane was so far destroyed that ammonia produced scarcely any effect upon the nose.

Hydroselenuret of potash dissolved in water becomes covered with a pellicle at first of a cinnabar red colour; but which, as it increases in thickness, becomes greyish. When the liquid is mixed with muriatic acid, it becomes muddy, and deposits a red powder. Selenium dissolves in the fixed alkalies both by the moist way and by fusion. The alkaline selenurets have a cinnabar red colour; those of barytes and lime have the same colour, but they are insoluble. Selenium dissolves likewise on the fixed oils, to which it gives a red colour. These solutions have no hepatic smell, as is the case with similar solutions of sulphur.

Selenium dissolves in nitric acid when assisted by heat. When the solution is evaporated in a retort, it leaves a crystalline mass, which sublimes easily in the form of crystalline needles, often a foot long. This sublimate is very soluble both in water and alcohol. Its taste is purely acid, it reddens litmus, and forms peculiar salts with the alkalies. It is, therefore, an acid having selenium for its base. Its name, of course, will be *selenic* acid. The alkaline seleniates crystallize with difficulty, and attract humidity from the atmosphere. When the seleniate of ammonia is heated, it is decomposed. A little ammonia is disengaged, after which selenic acid sublimes; but the greatest part of the ammonia is decomposed. Water and azotic gas is disengaged, and the selenium remains in a state of fusion, and may be afterwards sublimed. Seleniate of barytes is soluble in water; but scarcely soluble in alcohol. It crystallizes in needles, which gradually accumulate in such a way as to form globular crystals in which the fibrous structure cannot be detected even by a microscope.

If a little muriatic acid be poured into a seleniate, and then a plate of zinc be introduced into it, the selenium is precipitated in the metallic state. The zinc appears at first as if it were covered with a pellicle of copper; then the selenium is deposited in red flocks. If sulphuric acid be substituted for muriatic, the precipitation goes on with more difficulty. The precipitate assumes a grey colour, and contains sulphuret of selenium. If a current of sulphureted hydrogen gas be made to pass through a solution of selenic acid in water, the selenium is precipitated of an orange colour; but becomes red when dried. When heated it melts, may be distilled over, and forms an orange-coloured transparent matter.—(See *Annals of Philosophy,* xi. 291; and Ann. de Chim. et de Phys. vii. 199.)

VI. ALKALIFIABLE COMBUSTIBLES.

1. *Lithina, a new fixed Alkali.*—For this very interesting discovery we are indebted to M. Arfvredson, an ingenious pupil of Berzelius. He found it in a mineral first observed by M. d'Andrada in the mine of Uto, in Sweden, and called by him *petalite.* This mineral, according to the analysis of Arfvredson, is composed of

Silica	80
Alumina	17
Lithina	3
	100

This new alkali is extracted from the petalite in the usual way, by calcining the mineral in powder with carbonate of barytes, separating all the earths, and obtaining the alkali united to an acid. M. Arfvredson suspected at first that it was soda; but was induced to subject it to a more rigid examination from the great capacity for saturation which it displayed. The result was the discovery of its peculiar nature. The following are the most remarkable characters of this alkali.

Most of its combinations with acids are very fusible. The sulphate and muriate liquify long before they are heated to redness. The carbonate melts just when red hot, and in that state attacks the platinum crucible almost as violently as the nitrate of another alkali. The sulphate crystallizes readily, and the crystals contain no water of crystallization. Their solution is neither precipitated by muriate of platinum, nor by tartaric acid. The muriate is very deliquescent; more so, perhaps, than muriate of lime. The nitrate crystallizes in rhomboids, and attracts moisture rapidly. The carbonate is soluble with difficulty in water.

When the solution is evaporated, the salt crystallizes in very small prisms. Its capacity for saturating the acids is greater than that of magnesia itself.

These experiments have been repeated and confirmed by M. Vauquelin. He found further, that it unites with sulphur, and forms a yellow-coloured sulphuret, and that it contains 43·5 per cent. of its weight of oxygen. From this analysis it is likely that the weight of its atom will be about 2·25.

Sir H. Davy has not only obtained the new alkali, but has succeeded in reducing it to the metallic state. The metallic basis, to which the name of *lithium* will of course be given, bears a strong resemblance to the other alkaline metals, especially to sodium; to which it seems to be the most nearly allied. —(See *Annals of Philosophy*, xi. 291, 373; and Ann. de Chim. et de Phys. vii. 199.)

2. *Influence of the Metals on the Production of Potassium with Charcoal.*—M. Vauquelin, after roasting a portion of sulphuret of antimony in order to deprive it of its sulphur, fused it in a crucible with its own weight of tartar. The mass of metal obtained had a greyish white colour, without lustre, and a granular texture. When put into water, an effervescence took place, hydrogen gas was evolved, and the water was found to contain a solution of potash; two grammes of this metal evolved 30 cubic centimetres of hydrogen gas, and $3\frac{1}{10}$ grammes evolved 47 cubic centimetres. Hence M. Vauquelin concludes that the antimony was alloyed with the 20th of its weight of potassium. When this metal was exposed to the air, it became moist on the surface, and the potassium was converted into potash; but in naphtha it was kept for 24 hours without any change. Bismuth, being fused with tartar, formed a similar alloy. When the experiment was tried with the oxide of lead, a button of a grey colour was obtained, fibrous and brittle, affecting the tongue with an alkaline taste, and restoring the colour of litmus reddened by an acid; but not effervescing in water.

From these facts, Vauquelin concludes that in all probability other metals, which are reduced by means of alkaline fluxes, contain greater or smaller quantities of potassium, which modify their properties, and which are dissipated when the metals are refined or exposed to the air.—(Ann. de Chim. et de Phys. vii. 32.)

3. *Metallic Sulphurets.*—M. Frere de Montizon is of opinion that the metallic sulphurets are composed of determinate volumes of sulphur and metal united together. The following table exhibits the evidence upon which this opinion is founded.

Sulphurets of	Authors of the Analysis.	Sp. Grav. of the Metals.	Quantity of Metal.		Reduced to Volumes.		
			By Weight: sulph. =20.	In Vol.; sul. = 10·05.	Sul-phur.	Metals.	
Mercury	Berzelius.	13·599	125·5	9·227	1	1	or 0·918
Mercury	Seguin.	13·599	131·26	9·652	1	1	0·960
Tin.	Berzelius.	7·291	73·5	10·081	1	1	1·003
Nickel	Proust.	8·279	42·55	5·140	2	1	1·002
Arsenic......	Laugier.	8·308	27·62	3·324	3	1	0·992
Molybdenum.	Bucholz.	7·400	30·0	4·054	5	2	2·019
Zinc	Gay-Lussac.	6·861	41·0	6·121	5	3	3·045
Cobalt.......	Proust.	8·5384	50·0	5·855	5	3	2·913
Antimony....	Berzelius.	6·7021	53·69	8·011	5	4	3·986
Silver.	Marcet.	10·4743	135·0	12·889	4	5	5·130
Lead.........	Berzelius.	11·224	129·5	11·538	7	8	8·036
Bismuth......	Berzelius.	9·7654	86·35	8·843	8	7	7·099
Copper......	Chenevix.	8·895	40·0	4·497	9	4	4·027
Iron.	Thenard.	7·788	34·5	4·430	9	4	3·967

(Ann. de Chim. et de Phys. iii. 124.)

4. *Crystals of Protoxide of Lead.*—M. Houton-Labillardiere dissolved a quantity of litharge in soda, and set it aside during the winter. It deposited white semitransparent crystals, about the size of a pin-head, and having the form of regular dodecahedrons. These crystals possessed all the properties of protoxide or yellow oxide of lead.—(Ann. de Chim. et de Phys. vii. 218; and *Annals of Philosophy*, ix. 468.)

5. *Peroxide of Tin.*—Berzelius had conceived that the oxide of tin obtained from the *fuming liquor of Libavius* was different from that formed by means of nitric acid; but in consequence of some observations of Gay-Lussac, in which he stated his reasons for calling in question the diversity of these two oxides, Berzelius was induced to examine the subject with more care than he had formerly done. His experiments show clearly enough that the two oxides contain the very same proportion of oxygen; but they exhibit differences in their chemical characters, which seem to be owing to the different state of their aggregation, occasioned by the different modes of preparing them. The oxide formed by means of nitric acid combines with sulphuric acid; but does not dissolve in that acid, whether it be concentrated or diluted; but the oxide from the liquor of Libavius dissolves in an excess of diluted sulphuric acid, and is not again deposited even by boiling the solution. Nitric acid is incapable of dissolving the oxide prepared by means of nitric acid; but nitric acid dissolves the oxide from the liquor of Libavius, and is entirely neutralized by it. It acquires an astringent taste. The oxide is not precipitated by exposing the solution to the air; but it precipitates when the liquid is raised to the temperature of 122°. When muriatic acid is poured upon the oxide prepared by means of nitric acid, it acquires a yellow colour;

but dissolves little of the oxide. But if the acid be decanted off, and a sufficient quantity of water be poured upon the residual oxide, a complete solution is effected. Muriatic acid throws it down again, and the precipitate, which is a neutral muriate, may be again dissolved in pure water. This aqueous solution coagulates when heated, how dilute soever it may be. The oxide from the liquor of Libavius dissolves completely in muriatic acid, and is not precipitated by an addition of that acid in excess. The liquor of Libavius dissolves in concentrated muriatic acid just as well as in pure water.—(Ann. de Chim. et de Phys. v. 149.)

6. *Chameleon Mineral.*—This name has been given by chemists to a mixture of black oxide of manganese and caustic potash fused together in a crucible. The mass is green. At first it forms a green solution in water, and this solution passes through the suite of colours constituting the coloured rings into red. Some valuable observations on this compound, first pointed out by Scheele, have been made by Chevreul (Ann. de Chim. et de Phys. iv. 42); and by MM. Chevillot and Edwards (ibid. p. 287). Chevreul showed that it existed in two states; namely, the green and the red, and that it is a compound of pure oxide of manganese and potash. Chevillot and Edwards ascertained that it might be formed by means of any pure oxide of manganese and potash; that during its formation, oxygen gas is absorbed, and that this absorption is a maximum when the quantity of the oxide of manganese is equal to that of the potash. The green colour is most beautiful when the quantity of potash considerably exceeds that of the manganese. These gentlemen inform us that they succeeded in obtaining the red cameleon mineral in crystals by evaporating its solution. Their method was to form the chameleon by heating together equal weights of pure potash and black oxide of manganese. The solution of this in water is decanted off to get rid of the precipitate; it is then evaporated rapidly till it begins to deposit crystals. The liquid is then kept in a heat below that of boiling water. Red needles are deposited, varying in length from two lines to eight. These crystals are permanent in the air, and give a very strong red colour to water.

These observations are curious, but they do not make us acquainted with the real nature of this singular compound.

7. *Platinum.*—Vauquelin has succeeded in forming sulphuret of platinum, and has ascertained the characters of this compound. Happening to prepare a sulphuret of soda in a platinum crucible, he observed, on dissolving the sulphuret in water, a residuary black matter in needles. When this matter was heated in the open air, it gave out the odour of sulphurous acid, and left metallic platinum behind. It was, therefore, sulphuret of platinum, and had been formed by the action of the sulphuret of soda on the crucible. He formed the same sulphuret by heating

together in a platinum crucible a mixture of ammonia-muriate of platinum, sulphur and carbonate of soda, in the proportion of equal weights of each; by heating together one part of ammonia-muriate of platinum and two parts of sulphur in an earthen crucible; and by heating together one part of platinum in a very fine powder and two parts of sulphur.

Sulphuret of platinum thus prepared has the form of black, brilliant needles. When heated in the open air it loses from 15 to 16½ per cent. of sulphur. We may, therefore, consider it as a compound of

Platinum	84	10·5
Sulphur	16	2·0
	100	

When heated in close vessels, this sulphuret undergoes no further change than a kind of fusion. The simple acids do not attack it.

When a current of sulphureted hydrogen gas is passed through a solution of platinum in an acid as neutral as possible, a black powder falls, which, when made thoroughly dry, still retains a portion of water, which it gives out at a strong heat, along with some sulphurous acid, and then a sulphuret remains similar to that formed by the dry way.

When the solution of platinum in nitromuriatic acid is exposed to heat, a submuriate of platinum is obtained, which is insoluble in water, and which is decomposed by potash or soda, leaving a black oxide, containing, according to the analysis of Vauquelin, between 15 and 16 per cent. of oxygen. Thus it nearly agrees in its composition with the sulphuret; whereas the other metals combine with twice as much sulphur as they do of oxygen.—(Ann. de Chim. et de Phys. v. 260.)

These experiments, compared with those of Berzelius, Edmund Davy, and Cooper, demonstrate the imperfect state of our knowledge of the oxides of platinum.

8. *Brass.*—M. Chaudet had occasion to analyze three specimens of brass. The first was very ductile, and much esteemed for those articles that required hammering; but it was not easily turned on the lathe. The other two possessed much less ductility; but answered very well for those articles that required to be turned on the lathe. The result of his analyses was as follows:

First specimen. Brass made at Romilly.

Copper	70·10
Zinc	29·90
Tin	Trace

Second specimen. Common brass of commerce.

Copper	61·59
Zinc	35·30
Lead	2·86
Tin	0·25
	100·00

Third specimen. Stolberg brass.

Copper	65·80
Zinc	31·80
Lead	2·15
Tin	0·25
	100·00

(Ann. de Chim. et de Phys. v. 321.)

I had occasion some years ago to make the same observation. A friend of mine in London, who excels in the construction of time-pieces, showed me a piece of brass which he valued very highly. He gave it the name of old Dutch brass, and informed me that he was in the habit of buying it up whenever he could find it, and paying for it much higher prices than were demanded for modern brass. He was one of those persons who have a much greater veneration for former ages than for that in which they happen to live; and he stated this circumstance as a decisive proof of the deterioration of the arts in Europe. This information piqued my curiosity, and induced me to make a comparative analysis of these two varieties of brass. The old Dutch brass was much more ductile than Bristol brass, with which I compared it. I found the old Dutch brass composed in round numbers of

1 atom zinc = 4·125
2 atoms copper = 16·000

Bristol brass was composed of

1 atom zinc = 4·125
1 atom copper = 8·000

The first specimen, analysed by Chaudet, approached somewhat to the old Dutch brass; though it contained much less copper. The last two specimens examined were obviously similar to Bristol copper.

9. *Alloy of Tin and Antimony.*—M. Chaudet has ascertained by experiment that when tin is alloyed with the 20th part of its weight of antimony, muriatic acid is capable of dissolving the whole of the tin without touching the antimony. He proposes, therefore, as an easy method of analyzing an alloy of tin and antimony, to fuse the alloy with a quantity of tin such as will

reduce the proportion of antimony to one twentieth of the mixture. This alloy is then to be laminated, cut into slips, and boiled in an excess of muriatic acid in a matrass for two hours and a half. The antimony will remain undissolved, and its weight may be ascertained.—(Ann. de Chim. et de Phys. iii. 376.)

10. *Tin and Bismuth.*—M. Chaudet has likewise made experiments on the separation of tin from bismuth by means of muriatic acid. When an alloy is formed composed of equal weights of tin and bismuth, or of four parts tin and one of bismuth, it is quite brittle. The muriatic acid dissolves the tin just as easily as if no bismuth were present, and about one per cent. of the bismuth is at the same time dissolved. An alloy composed of 25 parts of tin and one of bismuth may be laminated; and muriatic acid, of the specific gravity 1·190, when boiled upon it 2¼ hours, dissolves all the tin without touching the bismuth. Hence the two metals, when united in this proportion, may be easily separated by means of muriatic acid.—(Ibid. v. 142.)

11. *Tin and Lead.*—Fischer ascertained, as had been previously done by Vauquelin and Proust, that when an alloy of tin and lead is digested in acetic or muriatic acid, none of the lead is dissolved; but only a portion of the tin. But when this alloy is digested in nitric acid, a portion of both metals is dissolved, though the acid is found always to contain a greater proportion of the lead.—(Schweigger's Journal, xx. 51.)

12. *Action of Aqua Regia on Antimony.*—Butter of antimony was formerly made by distilling a mixture of antimony and corrosive sublimate; but of late years the direct action of aqua regia upon this metal has been substituted. After the solution is at an end, the liquid is evaporated to dryness in a retort. The receiver is then removed, and the dry mass being made to pass into a new receiver, constitutes very beautiful butter of antimony. This process is much cheaper than the old one; but it is liable to some uncertainty, which M. Robiquet informs us may be obviated by attending to the following observations: The proportion of nitric acid ought to be to that of muriatic acid as one to four: when the solution takes place slowly, the chlorine is not dissipated as it is evolved. Hence there remains an excess of it, a superchloride is formed which is not decomposed by the evaporation; the consequence is that butter of antimony is not obtained. The inconvenience is easily obviated by putting the liquid into a flask, and agitating it with powdered antimony added in small quantities at a time, to prevent the evolution of too violent a heat. By this addition the superchloride is decomposed, and the whole changed into a simple chloride, which sublimes readily and constitutes chloride of antimony. When the solution of the antimony takes place with great rapidity, the *chlorine is dissipated.* There remains in consequence an excess

of nitric acid in the liquid. As the evaporation goes on oxide of antimony precipitates, and no butter is obtained. This inconvenience is obviated by adding a quantity of muriatic acid, and then continuing the evaporation. The nitric acid is decomposed, chlorine is formed, and when the liquid is evaporated to dryness butter of antimony is readily obtained.—(Ann. de Chim. et de Phys. iv. 165.)

VII. ACIDS.

1. *Sorbic Acid.*—Mr. Donovan's discovery of this acid has been confirmed by the subsequent experiments of Braconnot and Vauquelin, of which an analysis will be given in a subsequent number.

2. *New Method of procuring Chloric Acid.*—Mr. James Lowe Wheeler informs us that chlorate of potash may be decomposed, and chloric acid obtained in a state of purity by the following process: Mix a solution of chlorate of potash with an excess of fluosilicic acid prepared by causing water to absorb the fluosilicic acid gas till a pretty concentrated solution of it is obtained. Both liquids should be warm. Fluosilicate of potash is precipitated abundantly in a gelatinous state. Filter and saturate the liquid by means of carbonate of barytes. The chlorate of barytes may now be obtained in crystals. These crystals are to be dissolved in water, and the barytes precipitated by the cautious addition of sulphuric acid, according to the method employed by Gay-Lussac for obtaining chloric acid.—(Royal Institution Journal, iv. 287.)

3. *Union of Hydriodic Acid with the two Phosphureted Hydrogens.*—M. Houton Labillardiere has observed, that hydriodic acid gas is capable of uniting with its own volume of protophosphureted hydrogen gas. The two gases condense each other, and form cubic crystals of a white colour, which are volatilized by a gentle heat. This compound is decomposed by exposure to the air, by water, by alcohol, and by most of the salifiable bases, the protophosphureted hydrogen being evolved.

Common phosphureted hydrogen (viz. the gas composed of an atom of hydrogen and an atom of phosphorus) likewise combines with hydriodic acid gas. One volume of this gas unites with two volumes of the acid gas. When this combination is decomposed, protophosphureted hydrogen gas is evolved, and phosphorus precipitated.—(Ann. de Chim. et de Phys. vi. 304.)

4. *New Acid formed by the slow Combustion of Ether.*—Sir H. Davy observed that when a hot platinum wire is plunged into a vessel filled with a mixture of common air and the vapour of ether, the wire becomes red hot, and continues luminous till the whole of the ether is consumed. During this slow combustion of ether, a peculiar acid is formed, which is recognized by a particular odour which it exhales. Mr. Faraday made some experiments upon this acid; but as he was unable to obtain it

in a state of purity, and as he could form it only in small quantity, he did not succeed in determining its nature.

Its taste is slightly acid, and its odour very irritating. It reddens litmus, as does likewise its vapour. It forms neutral salts with potash and soda. Ammonia forms with it a volatile salt of a peculiar fetid odour. When the combination of this acid and potash is heated, the acid is speedily dissipated, and the potash is left behind. The compound of the new acid and potash precipitates the salts of silver and mercury, but not those of the other metals. This acid decomposes the carbonates of potash, soda, ammonia, and magnesia; but not that of lime even when recently prepared. When the salt which it forms with potash is heated in a retort, carbonic acid gas, carbonic oxide, and carbureted hydrogen gas, are driven off, while much charcoal remains behind in the retort. It would appear from this that oxygen, carbon, and hydrogen, constitute its elements.—(Journal of the Royal Institution, iii. 77.)

5. *Hydrocyanic Acid.*—From the experiments of M. Magendie it would appear, that pure hydrocyanic acid, prepared according to Gay-Lussac's method, is the most violent of all poisons. When a rod dipped into it is brought in contact with the tongue of an animal, death ensues before the rod can be withdrawn. M. Magendie has tried the diluted acid prepared according to Scheele's method, in cases of consumption. In several instances when this disease was apparently beginning, the administration of this remedy in small doses removed the cough and restored the patient to perfect health. It seems, therefore, to be a remedy highly worthy of further trial.—(Ann. de Chim. et de Phys. vi. 347.)

6. *Action of Oxalic Acid on Alcohol.*—M. I. C. D. Bauhof, of Aarau, has published a curious set of experiments on the action of alcohol on oxalic acid. He dissolved one part of crystallized oxalic acid in eight parts of absolute alcohol, put the mixture into a retort, and distilled off the alcohol. This process was repeated five or six times, till at last the whole oxalic acid disappeared, and was converted into an oily looking substance, obviously a compound of oxalic acid and alcohol. This substance possesses the following properties.

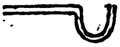
Its colour is brownish yellow. Its smell resembles that of the *sweet oil of wine*. Its taste is nauseous, bitterish, and has in it something metallic. It is heavier than water, and falls in it like oil drops; but is partially dissolved in that liquid by agitation. When first prepared, it gives a red colour to vegetable blues; but it may be deprived of the uncombined acid which it contains by agitation with carbonate of lime. It dissolves readily in alcohol; and when the alcohol is distilled off, it carries along with it some of the oily matter and a portion of acid, which may be detected by carbonate of lime. When mixed with water and distilled in a retort, it is decomposed; an acidulous water comes over, and there remains behind a very acid liquid, which on cooling deposits crystals of oxalic acid. When caustic ammonia is mixed with this oily matter, or with a solution of this oil in alcohol, a white precipitate immediately falls. This precipitate appears to be a compound of the oily matter with ammonia. It is destitute both of taste and smell, and is neither soluble in cold nor hot water. When heated, it is volatilized in a white smoke without undergoing decomposition. Neither nitric nor cold muriatic acid dissolves it; but boiling muriatic acid readily dissolves it. Concentrated sulphuric acid readily dissolves it when assisted by heat. The solution is transparent and colourless, and no precipitate appears when the acid is saturated by an alkali. When boiled with potash or soda, it is not decomposed, nor is any ammonia disengaged. When it is mixed with liquid potash, and distilled in a retort, the liquid that comes over contains ammonia and alcohol; and when the portion remaining in the retort is saturated with muriatic acid, and mixed with muriate of lime, a copious precipitate of oxalate of lime falls.—(Schweigger's Journal, xix. 308.)

VIII. ALKALIES AND EARTHS.

1. *Alkaline Sulphurets.*—Vauquelin has suggested that what is called sulphuret of potash is probably sulphuret of potassium; for he found that when sulphur and potash are combined together in close vessels by means of a red heat that the sulphuret formed contains a quantity of sulphuric acid which contains exactly the portion of oxygen that existed previously in the potash. Gay-Lussac has put this intricate subject in a very clear light. He finds that when equal weights of sulphur and potash are mixed together, and made to unite by exposure to a low heat, a sulphuret is formed which contains no sulphuric acid whatever. For when it is dissolved in water, only sulphurous and hyposulphurous acids can be detected in it; but when sulphur and potash are exposed to a red heat, abundance of sulphuric acid is formed. It would appear then at a low heat, that sulphur and potash combine together, and form sulphuret of potash; but that at a red heat the potash is decomposed, and the mixture is converted into sulphuret of potassium and sulphuret of potash.—(Ann. de Chim. et de Phys. vi. 321.)

2. *Preparation of Alumina.*—Gay-Lussac has suggested an easy method of obtaining pure alumina. In France it is very easy to meet with alum formed by means of ammonia instead of potash. When this variety of alum is exposed to a strong heat, it loses its acid, its ammonia, and its water, and nothing remains but the alumina in a state of purity. Unfortunately this method of procuring alumina cannot be had recourse to in Great Britain, as all our alum is made by means of potash; and, certainly, ammonia alone is never employed in its formation; for ammonia could not be procured, even by means of urine, at so

low a rate in this country as the muriate of potash can. If a cheap mode of preparing alumina could be fallen upon, that earth might be substituted with advantage in some of our manufactures for alum.

3. *Solution of Silver and Ammonia.*—Mr. Faraday has made some experiments upon the oxide of silver, obtained by dissolving the common oxide of that metal in ammonia, and exposing the solution to the open air. A brilliant pellicle forms on the surface, which he conceives to be a peculiar oxide containing about ⅔ the quantity of oxygen that exists in the common oxide of silver. His mode of operating was to put the dry oxide into a tube and decompose it by heat. The weight of silver and the bulk of oxygen gas evolved gave the constituents of the oxide. Experiments made in this way are liable to some uncertainty from the carbonic acid with which the oxide of silver is liable to combine, and from the variable proportions of common air with which the gaseous product is mixed. There is a method by which this last source of error may be guarded against, which I have long been in the habit of employing in delicate experiments. I put the substance from which the gas is to be extracted, into a very small tubulated retort, the extremity of the beak of which is bent in this shape . This beak is put into the small cup of a mercurial air holder, which I have employed for many years. It was made originally according to the model of Mr. Clayfield's mercurial gasometer; but Newman's improved mercurial trough will answer rather better. After all the gas which can be driven off by heat has been extricated, I put out the lamp, and allow the apparatus to remain unmoved for some hours, till the whole of the gas resumes the temperature of the apartment. The same bulk of gas that originally filled the retort will return into it, on account of the unimpeded communication between the jar containing the air and the retort; for I take care to prevent any mercury from lodging in the bend of the beak. Thus we obtain the exact volume of gas that is actually evolved, unmixed with any portion of volume derived from the air in the retort. If the gas requires to be analyzed, I previously ascertain the quantity of air which the retort contains, and make allowance for this proportion of common air in my analysis; for it is obvious that the gas both in the retort and jar will be of exactly the same quality.

Mr. Faraday rather overrates the weight of oxygen gas. According to him, 100 cubic inches of it weigh 34·072 gr.; whereas the true weight does not exceed 33·888 gr.

From Mr. Faraday's experiments it follows, that the oxide of silver with which we were previously acquainted, is composed of 100 silver + 7·382 oxygen, and his new oxide of 100 silver + 4·764 oxygen.

If we were to take the mean of these two sets of experiments, on the supposition that the oxygen in the protoxide is two thirds of that in the peroxide, we should have the composition of the two oxides as follows:

Silver.

Protoxide 100 + 4·8584 oxygen
Peroxide 100 + 7·2876

Now this last number I consider as a very near approximation indeed to the real quantity of oxygen in the peroxide of silver.

The objection to the admission of this new oxide of silver is the equivalent number for peroxide of silver, which we know from the nitrate of silver must be very nearly 14·75; while the sulphuret of silver and horn silver show us unequivocally that the weight of an atom of silver must be nearly 13·75. Were we to admit this new oxide, it would raise the weight of an atom of silver to 41·25, and that of peroxide of silver to 44·25, which is three times the present, and quite inconsistent with the composition of nitrate of silver. I am disposed, therefore, to believe, that this new oxide of Mr. Faraday is merely a mixture of oxide of silver and of metallic silver. Probably acetic acid, if the new oxide were digested in it, would dissolve the oxide, and leave the metallic portion behind.—(Journal of the Royal Institution, iv. 268.)

4. *Fulminating Silver.*—Mr. Faraday finds that fulminating silver may be obtained from any oxide of silver, even though it contain carbonic acid, by pouring over it a mixture of caustic potash and ammonia. The potash absorbs the carbonic acid, while the ammonia unites to the silver or its oxide. During the action of ammonia on silver, there is the evolution of a quantity of azote.—(Ibid.)

5. *Combination of the Chlorides with Ammonia.*—Mr. Faraday has published a useful set of observations on the action of various chlorides on ammoniacal gas.

(1.) Well fused chloride of calcium put into ammoniacal gas rapidly absorbs it and falls into a white powder. When this powder is heated, it gives out ammonia rapidly. When put into chlorine, it burns spontaneously, with a pale yellow flame.

(2.) Fused chlorides of barium and strontium absorb the gas very slowly, and undergo little change in their appearance.

(3.) Thirty grains of fused chloride of silver absorbed 40 cubical inches of ammoniacal gas. The chloride fell into a white powder, which blackened on exposure to the light. When heated, the whole gas was given out again unaltered. When placed in chlorine, it inflamed spontaneously, and the ammonia was decomposed. If the chloride be not fused, it gives the same compounds in a much shorter time. A strong solution of chloride of silver in ammonia was left for some weeks in a phial covered only by paper. Some flat rhomboidal, transparent, and colourless crystals, were deposited, which appeared to be composed of horn silver and ammonia united. This compound was easily decomposed.

(4.) Corrosive sublimate does not seem to absorb ammoniacal gas. Calomel absorbs it more rapidly. Chloride of lead and chloride of bismuth exert but little action.

(5.) Chloride of copper absorbs ammoniacal gas copiously, and falls into a blue powder.

(6.) Protochloride of iron absorbs a great quantity of ammoniacal gas, and is converted into a very light, adhesive, white powder. When exposed to the air, it immediately changes colour, becoming yellow, brown, then green, and ultimately black. This is owing to the absorption of aqueous vapour; of the presence of which it constitutes a very delicate test.—(Royal Institution Journal, v. 74.)

6. *Soaps.*—M. Chevruel has shown that all oils are divisible into two portions; one portion, usually solid, he calls *stearine;* the other, usually liquid, he calls *elaine.* Both of these oily bodies unite with alkalies in definite proportions, and are converted by the union into substances having acid qualities, which he has distinguished by the names of *margaric acid* and *oleic* acid. The equivalent number of margaric acid is 33, while that of oleic acid is 36.

Some valuable experiments on soap-making have been published, by M. Colin, in the Annales de Chimie et Physique, iii. 1. They are not of such a nature as to admit of abridgment; but they are well entitled to the attention of the practical soap-maker, who might, perhaps, acquire ideas from their perusal that would enable him to ameliorate some of his processes.

7. Since the original paper on *Morphia*, by Sertürner, of which an abstract was published in the *Annals of Philosophy* more than a year ago, several papers on the same subject have appeared, an account of which will be given hereafter.

IX. SALTS.

1. *Property of certain Salts to give their crystalline Form to a much larger Proportion of other Salts.*—M. Beudant has made an important set of experiments on this subject, which is interesting chiefly by showing us that the real mineral species which give the form may be fixed with a very great proportion of other substances, without any alteration in the crystalline form being induced. M. Beudant found that when two different salts were mixed together in certain proportions, and the solutions were crystallized, the crystals obtained never contained the two salts in the same proportions that had been originally mixed, but in some other proportion. He found that crystals might be obtained composed of 85 parts of sulphate of zinc and 15 parts of sulphate of iron, of 91 parts of sulphate of copper and 9 parts of sulphate of iron; and of 72·75 parts of sulphate of copper, 24·25 parts of sulphate of zinc and 3 parts of sulphate of iron; and yet all of these crystals have the form of the crystal which distinguishes sulphate of iron.—(Ann. de Chim. et de Phys. iii. 281; and *Annals of Philosophy*, ix. 262.)

Dr. Wollaston is of opinion that the crystals obtained by M. Beudant in the preceding experiments are not mere mixtures, but chemical compounds. This he concludes from the transparency of the crystals, a quality which they could not possess if they were mere mixtures; because their constituents differ so much in their refractive power. He found also that crystals could be obtained composed of about four parts of sulphate of zinc and one part of sulphate of copper, which possessed, as far as could be judged, the exact crystalline form of sulphate of iron. Sulphate of iron, according to Dr. Wollaston, crystallizes in rhombic prisms with angles of 80½° and 82°, or more.

Sulphate of nickel crystallizes in octohedrons, or in four-sided prisms terminated by four-sided pyramids. Sulphate of nickel-and-potash crystallizes in rhombic prisms.—(*Annals of Philosophy*, xi. 283.)

I think it right to mention here that the experiments of M. Beudant are not quite so original as he supposes them to be. In the eighth volume of the second series of Gehlen's Journal, published in 1809, there is a very long paper by Professor Bernhardi, entitled "*Gedanken uber Krystallogenie und Anardnung der Mineralien, nebst einagen beilagen über olie Krystallisation verschiedener Substanzen.*" In this paper (page 386) will be found a number of experiments by Professor Bernhardi on the crystallization of various mixtures of green, blue, and white vitriol, and the analyses of the resulting salts by Bucholz. Approximations were obtained to the results of Beudant, and we find several curious experiments peculiar to Bernhardi entitled to attention.

2. *Property which Tartar has of dissolving many Oxides.*—It has been long known to chemists that the cream of tartar is an excellent solvent of metallic oxides. On that account Gay-Lussac recommends it to our attention as a very useful substance in chemical analyses.

When we consider the great solvent property of cream of tartar, and that it is even capable of dissolving various oxides, which are insoluble in tartaric acid, as the protoxide of antimony, it is not easy to form an accurate idea of the way in which it acts. Gay-Lussac seems inclined to the opinion that in most of these combinations it acts the part of a simple acid. According to this view, tartar emetic would be a compound of the acid *cream of tartar* and of protoxide of antimony. This obscure subject is deserving of further investigation.—(Ann. de Chim. et de Phys. iii. 281.)

3. *Salts of Platinum.*—Hitherto very little real progress has been made in the knowledge of the salts of platinum. It has been scarcely possible to obtain the oxides of this metal in a state of purity and capable of uniting with acids; and when the muriate of platinum is mixed with solutions of other neutral salts, nothing is obtained but triple salts, which vary so much in their appearance and properties that it is difficult to form correct ideas of their composition. Vauquelin has published

some experiments on the salts of platinum; and every thing coming from a chemist of such experience is entitled to attention.

When common muriate of platinum is exposed to a heat sufficient to drive off a portion of its acid, chlorine is disengaged, and the salt acquires a fawn-brown colour, and loses its taste and its solubility; and when 100 parts of it are exposed to a strong heat, they leave 72·5 parts of metallic platinum. Two opinions may be entertained respecting the nature of this brown residue. 1. It may be a chloride of platinum; on which supposition it would be a compound of

Chlorine	27·5	4·5
Platinum	72·5	11·863
	100·0	

2. It may be a compound of muriatic acid and oxide of platinum. This is the opinion entertained by Vauquelin. If we suppose the oxygen in the oxide, as seems to follow from Vauquelin's experiments, to be a compound of

Platinum	84
Oxygen	16
	100

then the oxide of platinum in this salt must amount to 86·3, and of course it must be a compound of

Muriatic acid	13·7	4·625	9·250
Oxide of platinum.	86·3	29·134	14·567
	100·0		

This last supposition would make the weight of an atom of platinum 12·567 if we consider the oxide to contain two atoms of oxygen. For my own part I think it most probable that the fawn-coloured powder obtained from the muriate is rather a chloride than a submuriate.

When a solution of muriate of platinum, as neutral as possible, is mixed with the requisite proportion of common salt, a triple salt is formed which crystallizes with facility in fine crystals of a beautiful orange red. If instead of common salt, caustic soda be added in such a proportion as not to be in excess, the liquid becomes of a dark brown colour, and nothing precipitates. If this liquid be allowed to evaporate spontaneously, yellowish brown crystals are obtained, forming plates like mica, among which some may be perceived of a pearl-grey colour, and very brilliant. These crystals are perfectly neutral. They are very soluble in water, do not deliquesce, and the solution has a deep brown colour. Sal-ammoniac occasions in it a precipitate of a greenish yellow colour, and the mother water preserves its brown colour; but when sal-ammoniac is dropped into the salt, made directly by the mixture of muriate of platinum and common salt, a fine lemon-yellow precipitate falls, and the mother water remains nearly colourless. But these two salts, though so different in their appearance, are composed of nearly the same proportions of constituents. The first contains most water and acid, while the one formed by the addition of soda seems to contain the most metal.

When sulphuric acid is mixed with muriate of platinum, if the mixture be long enough boiled, and a sufficient quantity of sulphuric acid be employed, the whole of the muriatic acid is driven off, and a sulphate of platinum formed. This sulphate, when concentrated, appears black; but it becomes green when diluted with water. It is deliquescent, and does not seem capable of crystallizing. When mixed with sulphate of potash and evaporated, a green flocky precipitate falls, and the liquid becomes almost colourless. This precipitate is a triple compound of sulphate of platinum and sulphate of potash.—(Ann. de Chim. et de Phys. v. 264, 392.)

4. *Composition of certain Carbonates.*—Professor Berzelius informs us that he has been occupied of late in making experiments on the combination of carbonic acid with certain bases. He finds that there exists a kind of double salt, composed of the carbonate and hydrate of the same base, in which the carbonate is destitute of water of crystallization. The blue carbonate of copper is a compound of two atoms of carbonate of copper with one atom of hydrate. Magnesia alba is a compound of three atoms of carbonate of magnesia with one atom of hydrate of magnesia. The subcarbonate of zinc, both the artificial and the native, is a compound of three atoms of subcarbonate of zinc and one atom of hydrate of zinc.—(Ann. de Chim. et de Phys. vii. 206.)

The analyses of the blue and green carbonates of copper, by Mr. Richard Phillips, do not well agree with these statement of of Berzelius. According to Mr. Phillips, the green carbonate of copper is a compound of

Peroxide of copper..........	72·2	or 1 atom nearly
Carbonic acid..............	18·5	1 atom
Water....................	9·3	1 atom
	100·0	

He found the blue carbonate to be a compound of

Peroxide of copper..........	69·08	or 3 atoms
Carbonic acid..............	25·46	4 atoms
Water....................	5·46	2 atoms
	100·00	

Here the carbonic acid is obviously too great to admit of the sition that any portion of the oxide is not united with it. yal Institution Journal, iv. 273.)

5. *Union of Peroxide of Uranium and Carbonate of Potash.*—M. Chevreul has observed that the peroxide of uranium unites with carbonate of potash, and forms with it a crystallizable salt.—(Jour. de Phys. lxxxiv. 472.)

6. *Subsulphate of Alumina.*—Stromeyer has analyzed the aluminite found some years ago at Newhaven in Sussex, and made at the same time comparative analyses of the aluminite of Halle, and of Marl near Halle. The result of his analyses is as follows:

	Newhaven.	Halle.	Marl.
Alumina	29·868	30·263	30·807
Sulphuric acid	23·370	23·365	23·554
Water	46·762	46·372	45·639
	100·000	100·000	100·000

It is obvious that all these are identical in their composition, and that they are compounds of

1 atom alumina
3 atoms sulphuric acid
13 atoms water

X. MINERAL WATERS.

1. *Mineral Spring of Caldas de Rainha.*—This is a hot spring, about 40 miles north of Lisbon, which has been long celebrated for its medicinal properties. The water contains sulphureted hydrogen, to which it probably owes most of its virtues. By Mr. Rennie's account, the country is red sand lying over coal. It is probably, therefore, similar to Warwickshire, and that large tract in the middle of England which consists of what may be called *new red sandstone*. Dr. Withering subjected the water to an imperfect analysis in 1795. He found its temperature 94°. One hundred and twenty-eight ounces of it yielded the following constituents:

Fixed air	¼ oz. measure
Hepatic air	6¼ oz. measure
Carbonate of lime	3½ gr.
Ferrum hepaticum	2½ gr.
Alumina	1¾
Silica	0¾
Magnesian salt	64
Selenitic salt	44
Common salt	148
	264

Mr. Rennie found its specific gravity 1·0058; 16 ounces of it being evaporated to dryness, left 24 grains of dry salts, which consisted of

Muriate of soda	12·2
Sulphate of soda	5·5
Sulphate of lime.	4·1
Sulphate of magnesia	1·7
	23·5

(Royal Institution Journal, v. 60.)

2. *Saltness of the Sea.*—M. Lamarche, in a voyage from Rio Janeiro to France, in the year 1816, collected sea water from the surface of the ocean in different latitudes, and delivered them in sealed bottles to Gay-Lussac. The specific gravity and saline contents of these specimens were determined by M. Despretz in Gay-Lussac's laboratory with all the requisite care. The following table indicates the results obtained. The first specimen denominated Calais, was taken up by Gay-Lussac himself in the mid-channel between Calais and Dover.

Latitude.	Longitude.	Specific Gravity.	Saline Contents per cent.
Calais	— —	1·0278	3·48
35° 00′ N.	17° W. from Paris.	1·0290	3·67
31 59	23 55′	1·0294	3·63
29 4	25 1	—	3·66
21 0	28 25	1·0288	3·75
9 59	19 50	1·0272	3·48
6 0	19 55	1·0278	3·77
3 2	21 20	1·0275	3·57
0 0	23 0	1·0283	3·67
5 2 S.	22 36	1·0289	3·68
8 1	5 16	1·0286	3·70
12 59	26 56	1·0294	3·76
15 3	24 8	1·0284	3·57
17 1	28 4	1·0291	3·71
20 21	37 5	1·0297	3·75
23 55	43 4	1·0293	3·61
Mean.		1·0286	3·65

(Ann. de Chim. et de Phys. vi. 426.)

Dr. Murray, in his late excellent analysis of the water of the Frith of Forth, found the saline constituents to amount to only about three per cent. But this estimate is certainly below the truth. The specific gravity of the water of the Frith of Forth is 1·029, which is greater than the mean of the preceding table. Its saline contents, therefore, must be at least 3·65 per cent. I have repeatedly evaporated the sea water of the Frith of Forth to dryness; but do not depend upon my results, as the experiments were conducted in an open vessel. Such experiments, in order to be correct, ought to be conducted in retorts, and the saline contents ought to be slightly reddened.

XI. VEGETABLE BODIES.

1. *Olivile.*—M. Pelletier, on making some experiments on the *gum* of the olive tree, found that it was composed essentially of two substances, one having a great analogy with the resins, the other of a peculiar nature, to which he gave the name of *olivile.* It contained also a small quantity of benzoic acid.

To obtain the *olivile* in a state of purity, M. Pelletier employed the following process. The *gum* was treated with rectified alcohol, which dissolved the whole of it. The liquid was filtered, and left for spontaneous evaporation. It gradually deposits crystals in flattened needles of a yellowish white colour. By redissolving them in alcohol and crystallizing a second time, or by washing them in sulphuric ether, they may be obtained of a very white colour, and in a state of purity. These crystals constitute the olivile. If the evaporation of the alcoholic solution be continued, crystals of olivile are deposited, always more and more coloured, and at last the whole assumes the form of a granular red mass. By washing this substance in ether, a portion of the colouring matter is dissolved. By repeated solutions in alcohol, and evaporations, the whole of the olivile may be obtained in a state of sufficient purity. Its properties are as follows:

It has the form of a white, brilliant, starchy powder, or of flattened needles. It has no smell. Its taste is quite peculiar, being at the same time bitter and sweet, and having something aromatic. It melts at the temperature of 158°, and when cooled has the appearance of a transparent resin of a slightly yellowish colour. In this state it becomes electric by friction, but does not appear to have undergone any chemical change. When thrown upon a red hot coal, it takes fire with difficulty, and burns with the emission of much smoke. When distilled, it furnishes water, acetic acid, and oil; but no ammonia.

It is scarcely soluble in cold water. Boiling water dissolves the thirty-second part of its weight of it. The solution is transparent and colourless; but becomes milky on cooling, from the separation of the olivile, which remains long suspended in the liquid. The alkalies facilitate the solution of olivile in water without altering its nature when they are not concentrated.

Nitric acid dissolves it without the assistance of heat, acquiring a deep red colour. When heat is applied, the action increases very much, the red colour disappears, and the liquid becomes yellow on cooling. Much oxalic acid is deposited, and some yellow, bitter matter is formed. Diluted sulphuric acid has no action on olivile; concentrated sulphuric acid immediately chars it. Concentrated acetic acid dissolves it very readily, either cold or hot. The solution is colourless; and no precipitate falls when it is mixed with water, unless the olivile has been mixed with resin, in which case the resin is precipitated in the state of a yellowish powder.

The acetates of lead are the only salts that act upon solutions of olivile. They precipitate its aqueous solution in very white flocks, which are soluble in acetic acid.

Alcohol is the best solvent of olivile; when hot, it appears to dissolve it in any quantity whatever. Sulphuric ether has no action on it, neither have the fixed or the volatile oils; but these last bodies, while hot, dissolve a small portion of it, which they allow to precipitate as they cool.—(Ann. de Chim. et de Phys. iii. 105.)

2. *Extractive.*—This is a term which has been applied by chemists to a supposed vegetable principle, which is conceived to exist in a great many *extracts,* though it has never yet been separated nor obtained in a state of purity. The probability is, that no such principle exists. Braconnot has lately turned his attention to this intricate subject, and has analyzed a variety of vegetables, supposed to contain *extractive,* without being able to find any substance entitled to that name. His paper is a very elaborate one, and contains much useful information; but it is too long to be introduced here, and is not very susceptible of abridgment. We shall probably insert a translation of it into a future number of the *Annals of Philosophy.* He divides vegetable extracts into five genera.

(1.) Azotized extracts, slightly bitter.—The taste is slightly bitter. They are precipitated by the infusion of nutgalls. They contain two animalized principles. They yield ammonia when distilled. Examples; extract of borage, bugloss, cochlearia, cresses, senna, saponaria, &c.

(2.) Azotized extracts, very bitter.—They contain two animallized principles, one of which is very bitter, and soluble in alcohol. They are precipitated by nutgalls. They yield ammonia when distilled. Examples; extract of wild cucumber, marsh trefoil, fumitory, nux vomica, &c.

(3.) Hydro-azotized extracts, very bitter.—When heated, they burn with a lively flame, and furnish a quantity of hydrogen in excess of that which is requisite to form water with the oxygen present. They are precipitated by nutgalls; and they contain a hydrogenated principle often associated with other animal substances. Examples; extract of opium, aloes, colocynth, absinthium, gratiola, cinchona of St. Domingo, poppy, chelidonium, &c.

(4.) Oxygenized extracts.—Their taste is often saccharine; sometimes astringent, or acid. They contain no sensible portion of azote. They are not precipitated by nutgalls. When distilled, they yield a notable quantity of acid containing much oxygen united to hydrogen and carbon. They usually contain gum. Examples; extract of liquorice, onion, squill, calaguala, polypo dium, saffron, rhubarb, cachou, cassia, tamarinds; rob of elder, currants, &c.

(5.) Oxygenized extracts, very bitter.—Their taste is bitter, owing to the presence of a bitter principle associated with gum. They are not acted on by nutgalls. When distilled, they yield much acid, and no ammonia. Examples; extract of gentian, little centaury, quassia, &c.—(Jour. de Phys. lxxxiv. 267.)

3. *Oils contained in different Species of Corn.*—It is well known in this country that ardent spirits from unfermented barley have a peculiar odour, distinguished on the Continent by the name of *fousel.*—It has been the general opinion, since the time of Scheele, that this odour is owing to the presence of a peculiar oil. In the year 1804, I obtained from barley,, by digesting it in alcohol, a yellow, solid oil, possessed of exactly the flavour that distinguishes spirits from unmalted barley, and communicating that flavour to any spirit in which it was dissolved, I concluded that the odour was owing to this oil, which exists ready formed in barley. Some years after, Fourcroy and Vauquelin extracted the same oil from barley, and drew the same conclusion (Ann. du Museum d'Hist. Nat. vii. 7). Gehlen described the properties of this oil at still greater length (Journal, i. 277; New Series). Schräder has lately extracted a yellow oil from rye by the same process. This oil was of the consistence of butter; but was distinguished by no peculiar taste or smell, and had nothing similar to the flavour of *fousel* (Bibl. Univers. iv. 266). It is probable that every species of corn contains an oil in greater or smaller quantity; but no doubt the flavour which it communicates to spirits will differ with the oil. I think it extremely probable that if the distillation be conducted at too high a temperature, the nature of the oil may be altered, and its flavour greatly heightened, and rendered more disagreeable. I found it easy to distil the alcohol from this oil in a retort. Hence it is not very volatile. In all probability, then, manufacturers might succeed in obtaining their spirits free from all admixture of oil, and consequently without any peculiar odour, if they were to conduct their distillation at a lower temperature by means of a vacuum. Some such method would probably improve the flavour of spirits prodigiously, and render the importation of foreign spirits unnecessary.

4. *Vegetable Milk.*—It is sufficiently known that the milky juices of European vegetables have all an acrid or narcotic quality. But in South America M. de Humboldt observed a tree which yielded a milky juice destitute of these qualities, and employed by the natives as a nourishing article of food. This tree was called in the country *cow-tree*, and the milk of it on standing formed a film on the surface resembling in its pro-

petties the curd of milk. The two substances most abundant in the milk of plants belonging to the torrid zone are *caseum* and *caoutchouc*. The first, M. Humboldt considers as analogous to the curd in cows' milk; the second, to the butter.—(Ann. de Chim. et de Phys. vii. 182.)

5. *Garlic.*—From the experiments of M. Bouillon-Lagrange, it appears that garlic contains

1. A very acrid volatile oil.
2. Sulphur.
3. A small quantity of starch.
4. Vegetable albumen.
5. Saccharine matter.

(Ann. de Chim. et de Phys. iii. 109.)

6. *Rye, altered by the Disease called Ergot.*—M. Vauquelin has made a set of experiments on rye in this diseased state, chiefly to determine whether M. Decandolle's opinion, that the disease is produced by a vegetable of the fungous kind substituting itself for the usual grain of rye, or the common opinion that the grain of the rye is merely altered by disease, be true. M. Vauquelin inclines to the last opinion.

He extracted from the diseased rye, 1. A colouring matter of a fawn-yellow colour, separable by alcohol. 2. A white oil of a mild taste, which appears to abound in the grain. 3. A violet colouring matter, of the same shade as that of archil, but differing by its insolubility in alcohol. It dyes woollen and silk of a lilac colour. 4. An uncombined acid, which is probably the phosphoric. 5. A very abundant vegeto-animal matter, which runs readily into putrefaction, and which, when distilled, furnishes a thick oil and ammonia. 6. A small quantity of uncombined ammonia, which may be obtained by exposing the grain to the heat of boiling water. M. Vauquelin could neither detect starch nor gluten in the diseased rye.—(Ann. de Chim. et de Phys. iii. 337.)

7. *Ipecacuanha.*—MM. Pelletier and Magendie have subjected different species of this root to a chemical analysis. Some of the results obtained are interesting. Their first analysis was that of the bark of the root of the *psycotria emetica,* or the brown ipecacuanha of the shops. They first treated it with sulphuric ether, then with alcohol, then with cold, and lastly with hot water. What remained after the action of all these reagents they considered as *woody fibre.* The ether dissolved two kinds of oil; one volatile, to which the ipecacuanha owes its odour, and, perhaps, also its taste: another solid of a yellowish colour, and similar to tallow, which has no sensible action on the animal economy.

The alcohol dissolved some wax, and a peculiar principle, *to which ipecacuanha is* indebted for its emetic properties. On *that account they* have distinguished it by the name of emetine.

The cold water dissolved merely a quantity of gum, and the hot water a quantity of starch.

The following table exhibits the result of their analysis:

Oils	2
Emetine	16
Wax	6
Gum	10
Starch	42
Woody fibre	20
Loss	4
	100

Emetine, which is the important constituent of ipecacuanha, possesses the following properties:

When dry, it is in the form of transparent scales, of a reddish brown colour. It has scarcely any smell. Its taste is bitter and a little acrid, but not nauseous. It is not altered by exposure to a heat below that of boiling water. At a higher temperature it melts, swells, blackens, and is decomposed, being converted into water, carbonic acid, a little oil, and acetic acid; while a light coal remains behind. It is not altered by exposure to the air, unless the atmosphere be very humid, when it absorbs a little moisture.

Water dissolves it in great abundance, and the solution cannot be made to crystallize. It dissolves also readily in alcohol; but is insoluble in sulphuric ether.

Diluted sulphuric acid has no action on it. When that acid is concentrated, it chars it. Nitric acid readily dissolves it. The solution is at first red; by continuing the action it becomes yellow; nitrous gas is evolved and oxalic acid formed. Muriatic and phosphoric acids dissolve emetine without altering its nature. Acetic acid dissolves it with great facility. Gallic acid and the infusion of nutgalls throw it down both from water and alcohol. It is precipitated also by the acetate of lead, and by protonitrate of mercury and corrosive sublimate; tartar emetic has no sensible action on it. Half a grain of it excites violent vomiting, followed by sleep, and the patient awakes in perfect health. Six grains given to a dog occasioned the death of the animal in about 30 hours: the lungs and the mucous coat of the intestines were found in a state of violent inflammation.—(Ann. de Chim. et de Phys. iv. 172; and *Annals of Philosophy*, ix. 422.

8. *Analysis of different Species of Corn.*—M. Vogel, who has lately succeeded to the place of Gehlen, as Member of the Academy of Sciences at Munich, has published the result of his trials respecting the constituents of several species of corn.

Wheat flour from the *triticum hibernum*, the species usually *cultivated in this country*, yielded 68 parts of starch and 24 of gluten; while the flour from the triticum spelta, which grows on the banks of the Danube, yielded 74 starch and 22 gluten.

He could detect no gluten in oats; but he obtained an azotized substance, destitute of elasticity, and having no resemblance to gluten. Oats contain, besides a saccharine matter, a bitter principle and a fixed oil, of a yellowish green colour.

Rice furnished him likewise with a fixed oil, with a substance much more saccharine than that furnished by wheat, with a small quantity of albumen, and a great quantity of fecula. Rice may be made to ferment by means of leaven; but the bread formed of it is but little raised.—(*Annals of Philosophy*, ix. 314.)

Vogel could not succeed in making good bread by means of carbonic acid, as Edlin affirmed he had done. The following experiment, which I conceive to be of a similar nature, was successfully performed by a friend of mine. A quantity of carbonate of soda and of muriatic acid, just capable of neutralizing each other, and of forming the proportion of common salt usually mixed with a loaf of bread in this country, were weighed out separately. The carbonate of soda was dissolved in water, and this solution was well kneaded with the dough. The muriatic acid was then diluted with water and hastily kneaded with the same dough. The dough was now baked. It formed a loaf very well raised, and as good in every respect as common bread. The gentleman who performed this experiment was a baker by profession.

9. *Rice.*—M. Braconnot has published an elaborate analysis of rice. I have room here only for the table exhibiting the constituents, which he detected in two specimens of rice subjected to analysis.

	Carolina rice.	
Water	5·00	7·00
Starch	85·07	83·80
Parenchyma	4·80	4·80
Vegeto-animal matter	3·60	3·60
Incrystallizable sugar	0·29	0·05
Gummy matter approaching starch	0·71	0·10
Oil	0·13	0·25
Phosphate of lime	0·40	0·40
Muriate of potash	Trace.	Trace.
Phosphate of potash		
Acetic acid		
Vegetable salt with base of lime		
Ditto with base of potash		
Sulphur		
	100·00	100·00

(Ann. de Chim et de Phys. iv. 370.)

10. *Juice of Carrots.*—Laugier has observed that when the juice of carrots is subjected to fermentation, manna, in the state of crystals, makes its appearance in it.—(Jour de Phys. lxxxv. 472.)

11. *Potatoes.*—Vauquelin has subjected a great many different varieties of potatoe to analysis. The juice procured from the root by expression was the particular object of his research; and in this he has detected the following substances:

1. Albumen of a black colour.
2. Citrate of lime.
3. Asparagin.
4. A bitter aromatic resin.
5. Phosphate of potash and phosphate of lime.
6. Citrate of potash and citric acid.
7. A peculiar animal matter.

(Jour. de Phys. lxxxv. 113; and *Annals of Philosophy*, ix. 430.)

12. *Almonds.*—The emulsive seeds have been thought to consist principally of a mixture of starch and fixed oil. M. Vogel, however, has lately discovered that the bitter almond contains no starch but albumen, or a substance analogous to curd, in the proportion of 30 per cent. This interesting discovery has been confirmed by the result of an examination of the sweet almond by M. Boullay; and it is not improbable that the other emulsive seeds are similarly circumstanced.—(Schweigger's Jour. xx. 59; Journ. Pharm. Aug. 1817; *Annals of Philosophy*, ix. 426.)

13. *Copper as a Constituent of the Ashes of Plants.*—Bucholz and Proust announced a good many years ago that they had detected copper in the ashes of certain plants. Very lately Dr. W. Meissner, an apothecary in Halle, made a set of experiments on the same subject. He detected traces of copper in the ashes of the following seeds:

Grana Paradisi,
Cardomomum minus;

and the roots of

Curcuma longa,
Galanga;

but the quantity is so small that it is by no means easy to discover its existence at all. He found the action of the galvanic battery to be the most unequivocal means of detecting the presence of that metal when it exists in very small quantity in a mixed mass.—(Schweigger's Journal, xvii. 340.)

XII. ANIMAL SUBSTANCES.

1. *Nourishing Properties of Substances destitute of Azote.*—Most of my readers are probably acquainted with the very curious experiments made some time ago by M. Magendie, in Paris. He fed dogs on sugar, allowing them no other nourish-

ment except water. The animals swallowed the food with avidity; but they gradually became thin, and in about six weeks died of starvation. An ulcer always broke out in the cornea of the eyes, and they lost their sight some days before their death. The same experiments were repeated on other dogs, substituting gum and butter for sugar. The result in both cases was exactly the same. From these experiments, M. Magendie drew as a conclusion that food destitute of azote is incapable of nourishing dogs.—(Ann. de Chim. et de Phys. iii. 66.)

These experiments are of so decisive a nature that they seem at first sight perfectly conclusive. There is one circumstance, however, which would render it desirable that the experiments should be repeated in a somewhat different manner—I allude to the great influence of habit upon the digestive powers of animals. It is possible that the stomach of dogs may not be capable at once of digesting food so different from what these animals are accustomed to, as sugar, gum, and butter. But if the change of food were brought about gradually, and not all at once, is it not probable that dogs might be made to live upon sugar, gum, and even butter? A sheep is accustomed to live upon vegetable food, and it is incapable at first of digesting animal food; but it may be brought by degrees to relish animal food, and even to live on it. It is said that in such cases the animal becomes incapable of digesting vegetable food. This effect of habit renders it very difficult to draw unexceptionable consequences from experiments on living animals.

2. *Composition of Animal Substances.*—Berard has subjected several animal substances to analysis by heating them in a glass tube previously mixed with peroxide of copper. The following table exhibits their constituents as then obtained:

	Constituents by Weight.				Total.
	Azote.	Carbon.	Oxygen.	Hydrogen.	
Urea	43·40	19·40	26·40	10·80	100
Uric acid. ..	39·16	33·61	18·89	8·34	100
Butter.	00·00	66·34	14·02	19·64	100
Fat	00·00	69·00	9·66	21·34	100
Mutton suet.	00·00	62·00	14·00	24·00	100
Cholesterine.	00·00	72·01	6·66	21·33	100
Cetine.	00·00	81·00	6·00	13·00	100
Fish oil	00·00	79·65	6·00	14·35	100

Urate of barytes he found composed of

Uric acid.	61·64	100·00	15·667
Barytes	38·36	62·23	9·75
	100·00		

Urate of potash is composed of

Uric acid.	70·11	100·00	14·074
Potash.	29.89	42·63	6·00
	100·00		

(Ann. de Chim. et de Phys. v. 290.)

Dr. Prout has subjected urea, sugar, and uric acid, to analysis in the same manner as Berard. From the great degree of precision with which he makes all his experiments, and their very frequent repetition, in the present case I am disposed to place very great confidence in their accuracy. A full detail of these experiments has been inserted in the *Annals of Philosophy*, ix. 352.

Berard has made a very curious experiment. He mixed together

1 volume carbonic acid,
10 volumes carbureted hydrogen,
20 volumes hydrogen,

which nearly represent the elements of fat, and passed the mixture through a red-hot porcelain tube. He obtained a substance in small white crystals, lighter than water, soluble in alcohol, and fusible by heat into a substance similar to fixed oil. Dobereiner, also, by mixing coal gas and aqueous vapour in a red-hot iron tube is said to have produced a substance similar to fat.

3. *Cetine.*—This is the name which Chevruel has given to the substance known in commerce by the name of spermaceti. He has published a new memoir on the subject, in which he has altered some of his former opinions; but as I have hitherto seen only a part of this memoir, I think it better to defer this subject till our next historical sketch.

4. *Conversion of Animal Bodies into Fat.*—M. Gay-Lussac has announced it as his opinion that the apparent conversion of animal bodies into fat is merely a deception; and is nothing else than the wasting away of the muscular fibres while the fat remains. He states some experiments which corroborate this opinion. Fibrin of blood was kept in water renewed once every two or three days for three months. It was all wasted away, and no fat whatever remained. Muscle of beef and liver being treated in the same way, some fatty matter remained (Ann. de Chim. et de Phys. iv. 71). I have little doubt, notwithstanding these experiments, that in certain cases, at least, something more happens than mere putrefaction. A remarkable example occurred to me last winter. About the year 1684, a poor woman was drowned in a moss in Ayrshire, as she was going to visit her friends. She was carried to the neighbouring church-yard to be

interred; but the curate (for the church of Scotland at that time was episcopalian) refused to permit her body to be deposited in consecrated ground. She was in consequence carried back, and buried in the place where she was found. The proprietor of the estate had the curiosity last year to open the grave. The body was found quite entire, and even the plaid in which it had been wrapped was in good preservation; but the whole body was converted into a hard saponaceous matter. I had the curiosity to examine a portion cut from the thigh, which was sent to the Glasgow museum. It was hard and firm, and had the aspect of soap. On treating it with alcohol, I found that it was composed chiefly of the adipocire, which has been so often described and examined that it would be superfluous to give any description. But the whole was not adipocire; there remained undissolved by the alcohol a number of thin films, quite similar in appearance to the coats of the bladder. The quantity of fatty matter in this instance was by far too great to suppose it to have pre-existed in the living body.

5. *Poison of the Viper.*—From the experiments of Professor Mangili, it appears that the poison of the viper may be swallowed with impunity by animals, and that it preserves its poisonous qualities even after being kept 26 months.—(Ann. de Chim. et de Phys. iv. 169.)

6. *Colouring Matter of the Blood.*—Berzelius has published an instructive paper on this subject. According to him, Vauquelin's method of separating the colouring matter from blood by means of sulphuric acid, is unnecessary, and does not answer well. Berzelius's method is very simple.. Place the clot of blood upon bloating paper, to get rid of the serum as completely as possible; then put the clot into water. The colouring matter is dissolved, while the fibrin remains. By evaporating the water, the colouring matter may be obtained in a separate state. No iron can be detected in the colouring matter while undecomposed; but when reduced to ashes, about a half per cent of iron can always be separated.—(Ann. de Chim. et de Phys. v. 42.)

7. *Respiration of Tortoises.*—Few animals are able to live for any time when plunged under oil. Even those that can resist the vacuum of an air-pump, or which revive after being drowned in water, never revive if they have been kept for some time under oil. The leech alone is capable of remaining for some hours under oil with impunity. It appears from the experiments of Carradori, that the land tortoise possesses the same remarkable quality. He kept one under oil for six hours. When he appeared dead, he was taken out and exposed to the air, and recovered. The same tortoise lived under oil for 24 hours. On being taken out, he vomited a considerable quantity of oil; but died. Another tortoise lived 33 hours under oil; but was dead in 36 hours.—(Ann. de Chim. et de Phys. v. 94.)

8. *Urinary Calculus of a Horse.*—Bucholz has lately subjected a very remarkable calculus from a horse to a chemical analysis. This calculus had a brownish green colour, was destitute of smell, but had a bitter taste. Its specific gravity was 1·07526. It was composed of concentric coats covering a nucleus of hair. From its chemical properties it seems very similar to resin; though it is distinguished from vegetable resin by it's insolubility in sulphuric ether, by the feeble action of sulphuric acid on it, and by nitric acid converting it into Welter's bitter principle, and by some other characters of less importance. When this calculus was burned to ashes, it left the following substances:

Silica,
Phosphate of lime,
Carbonate of lime,
Alumina,
Oxide of iron,
Oxide of manganese, a trace,
Sulphate of lime, a trace.

(Schweigger's Jour. xvii. 1.)

The preceding historical sketch, from the length of time that has elapsed since the last was written, has extended to such a length, that I have thought it right to leave out most of the papers which have already made their appearance in the *Annals of Philosophy.*

(*To be continued.*)

ARTICLE II.

Biographical Sketch of Brisson.

BRISSON was born at Fontenai, on April 3, 1723, and like many others of his countrymen, who afterwards became distinguished for their scientific attainments, was originally destined for the ecclesiastical profession. Early in life, however, he was so fortunate as to attract the notice of Reaumur, from whom he acquired a taste for natural history, and under whose auspices he commenced his literary career, after he had renounced his original destination. He was employed by his patron in the arrangement of his cabinet, and was induced to form a new classification of the specimens, which was principally derived from their external characters and most obvious qualities. He afterwards determined to make a general application of the method which he had employed in Reaumur's cabinet; and beginning by the animal kingdom, he divided it into nine classes, depending upon their greater or less resemblance to man. In

1756 he published the first two classes, the quadrupeds, and the cetacea; the prevailing character of the work is simplicity, the descriptions and the nomenclature are all marked by this quality, and the whole seems to have been intended to convey the greatest possible quantity of information in the least assuming manner. In 1760 the third part, the ornithology, appeared, a work that contained more original matter and more scientific research than the former, and tended to raise his character to a higher rank as a naturalist. At this period, however, he had the misfortune to lose his friend Reaumur, and from some cause, with which we are not acquainted, Buffon and Daubenton, under whose care Reaumur's cabinet was placed, threw some obstacles to his use of it, and by this means almost compelled him to renounce his favourite pursuit.

Being thus deprived of his former occupation, he accepted an offer, which was made him by the Abbé Nollet, to become his assistant in the lectures on natural philosophy, which he delivered in the college of Navarre. In this new situation, he exerted all the energies of his mind upon experimental philosophy, which had been before bestowed upon natural history; and he seemed to have experienced no diminution of his ardour for science, by the change in the department to which he especially devoted himself. He published, in a succession of memoirs, the results of his inquiries on various topics, of which the most important is a paper which he presented to the Academy in 1772, on the specific gravity of metals. This was afterwards expanded into a separate treatise on the subject, which was published in 1787, and is said to have occupied his attention for 20 years; it is generally admitted to possess the merit of great accuracy in all its parts, and retains its estimation as a work of standard value. Brisson was one of the most active members of the commission that was formed in France to establish a new system of weights and measures; and it is probable that we are indebted to him for a considerable share of the merit, both of the plan and of the execution, of the method that was adopted. Besides his papers on individual subjects, he was the author of an elementary treatise, and a dictionary of natural philosophy, works of established reputation, which were extensively employed in France, and have been translated into other languages. He died of an apoplexy in 1806, and has left behind the well-earned reputation of an accurate and patient investigator of science rather than of a profound theorist, or an ingenious discoverer. What he aimed at he accomplished; accuracy was his great object; and he was more desirous of becoming useful, by removing obstacles in the road to knowledge, than of attempting himself to enter upon any new or intricate paths. His reputation with posterity will principally rest upon his treatise on the specific gravity of metals.

Article III.

On the Geography of Plants. By N. I. Winch, Esq.

(To the Editors of the *Annals of Philosophy.*)

GENTLEMEN, *Newcastle-upon-Tyne, May* 4, 1818.

In January last I did myself the honour of transmitting to you a paper on the distribution of vegetables indigenous in the north of England; I now continue those observations by some remarks on the growth of native and exotic forest trees and shrubs; and hope next month to conclude this slight essay on the geography of plants in our parallel of latitude, with a concise account of the fruits that ripen, and species of grain which come to perfection, at different heights in 55° North. By these data the temperature of the climate and the nature of the soils may, in some measure, be elucidated; but several meteorological facts must be deferred till I have leisure and opportunities to revise and correct my notes, which are not at present sufficiently complete to lay before your scientific readers.

Of forest trees, the oak first claims our attention. In the sheltered vales of Tyne, Derwent, and Tees, it attains to a large size, and may be considered truly indigenous; for enormous trunks and branches are dug out of all the peat mosses which are not situated at a very considerable elevation above the levels of the rivers; and this phenomenon occurs even among the recesses of the Cheviot mountains, a district which is now destitute of oaks. In Weardale and Teesdale, trees of a stunted growth may be traced to the elevation of 1,600 or 1,700 feet above the level of the sea. The river Dal, in Sweden, in lat. 60° 30′ North, and Christiana, in Norway, in 59° 56′, appear to be the northern limits of this valuable timber; but the oaks which I have noticed on the banks of the Gotha, in lat. 58°, were of very diminutive size.

The common elm of the southern counties of England (Ulmus campestris) is certainly not indigenous north of the Tees; and, of course, I cannot help suspecting that the elm mentioned by Von Buch as growing in the vicinity of Christiana, and by Wahlenberg to the north of the Lake Venner, in Vermland, will prove to be the Wych elm (Ulmus montana), or possibly the smooth-leaved elm (Ulmus glabra of Eng. Bot.). Even in sheltered plantations, the common elm does not attain to a considerable size; but the Wych elm is abundant in every hedge, and, together with the smooth-leaved elm, skirts our moors at the height of 2,000 feet.

The beech (Fagus sylvestris) and aspen (Populus tremula) are truly natives; but the former does not climb the hills to the same height as the oak, *but* flourishes beautifully in the vales. Von

Buch assigns the river Gotha as the northern boundary of the beech, and the province of Halland, in Sweden, as that of the aspen and black poplar (Populus nigra). Lightfoot doubts whether either the white or black poplar are natives of Scotland (see p. 616 and 618); nor have I ever seen these trees in a natural wood in the north of England. The lime (Tilea europæa), the chesnut (Fagus castanea), and the hornbeam (Carpinus Betulus), stand in the same predicament.

Large holly trees (Ilex aquifolium) are among the chief ornaments of many woods in the county of Durham, as is the yew (Taxus baccata) to the white calcareous cliffs in the romantic Dene at Castle Eden. In Borrowdale, and on the margins of the Cumberland and Westmorland lakes, the birch (Betula alba) equals in size and beauty the birches of Norway and Sweden; but it is not found on the mountains higher than the sycamore (Acer Pseudo Platanus), which in these subalpine regions is quite at home. Here too may be seen the mountain ash (Pyrus aucuparia); but the white beam (Pyrus aria) may be traced from the High Force of Tees to the sea coast, provided the soil rests upon limestone rocks. The alder (Alnus glutinosus) and marsh elder (Viburnum opulus) accompany every stream, and the hazle (Corylus avellana), black cherry (Prunus cerasus), bird cherry (Prunus padus), the spindle tree (Euonymus europæus), the raspberry (Rubus idæus), the common elder (Sambucus nigra), are found in all the woods from the sea shore to those situated at an elevation of 1,600 feet; but the common maple (Acer campestris) occurs only in the hedges of the flat country which surrounds Darlington.

The ash (Fraxinus excelsior) and white thorn (Mespilus oxyacantha), as well as the less useful crab tree (Pyrus malus) and black thorn (Prunus spinosa), abound through the whole district; but the bullace tree (Prunus insititia) is extremely rare; and the plumb tree (Prunus domestica), pear tree (Pyrus communis), black and red currants (Ribes nigrum and R. rubrum), the barberry (Berberis vulgaris), and gooseberry (Ribes grossularia), though now of frequent occurrence, I suspect were not originally natives of the soil. The four following shrubs are certainly indigenous: Ribes petræum, Ribes spicatum (rare), Ribes alpinum, and Ligustrum vulgare; but Lonicera xylosteum, which stands on the authority of Wallace, should be expunged from our Flora.

On the elevated moors between Blanchland, at the head of the Derwent, and Wolsingham, on the river Wear,* and even on the mountains of Cross Fell, at an elevation of nearly 3,000 feet, the roots and trunks of very large pines (Pinus sylvestris?) are seen protruding from the black peat moss, being exposed to view by the water of these bogs having drained off and left the peat bare; but this tree is no longer indigenous with us. And it may be worthy of remark, that the Scotch fir does not at this day attain the size of these ancient pines, though planted in similar moorland situations, even though the young trees be protected, and the plantations situated at a lower level. The spruce fir (Pinus abies) appears never to have been a native of this island, though the woods on the continent of Europe, both to the north and south of Britain, abound with it.

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* This is the only spot in Britain where Gyrophora glabra of Acharius has been detected in fructification.

In lowland situations it is impossible to ascertain the native from the exotic willows; but having remarked the blue willow (Salix cœrulea) in the highlands of Scotland, I conclude it may be indigenous here; but I apprehend the golden willow (Salix vitellina) has been brought to us from the south of Europe. On the banks of our subalpine rivulets is the true locality of Salix croweana, not in the hedges of Norfolk. (See Eng. Bot.) The weeping willow, a native of Syria, never ripens its wood, and of course never flowers in the north.

The furze (Ulex europæus), when it can no longer exist on open exposed moors, may be found in sequestered Denes at a height of 2,000 feet; here too terminates the growth of our most common bramble (Rubus corylifolius), where it is all but an evergreen, and where the fronds of many ferns survive the severity of our winters.

On the Fyall Alps, in Lapland, at 1,400 feet below the line of perpetual snow, Wahlenberg noticed the following shrubs: Salix glauca, Betula nana, Juniperus communis, Salix hastata, Arbutus alpina, Andromeda cœrulea, Andromeda polifolia, and Rubus chamæmorus; and at 600 feet higher, Salix lanata, Salix myrsinites, Azalea procumbens, Azalea lapponica, Vaccinium uliginosum, and Empetrum nigrum. It may not be amiss to compare these plants with those of a similar description found at 2,000 or 3,000 feet elevation in this latitude: Salix glauca, Betula nana, and Arbutus alpina, Salix myrsinites, Azalea procumbens, and Andromeda cœrulea do not reach us, though natives of the Scotch highlands. Salix lanata and Azalea lapponica are foreign to Britain; but Juniperus communis may be traced from the coast to the highest mountains; and Andromeda polifolia is comparatively speaking a lowland plant. Rubus chamæmorus flourishes on the Cheviots, on Cronkley Fell, and other moors in Teesdale, together with Empetrum nigrum; but Vaccinium uliginosum does not attain to so great an elevation. In the place of Arbutus alpina, we have Arbutus uva ursi, and of Salix lanata, a few scattered plants of Salix arenaria, on the Teesdale hills; and the summit of Skiddaw is covered with Salix herbacea, but without its usual attendant, Salix reticulata. Cistus marifolius and Dryas octopetala grow by the Black Ark on the highest part of Cronkley.*

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* This is also the habitat of Tofieldia palustris, a native of Lapland and North

There appears something enigmatical in the causes which affect the growth of many exotic shrubs well known in gardens and plantations; for many natives of the north of Asia, Portugal, Japan, and even South America, resist the severity of our winters much better than many which are indigenous in Italy, the south of France, and of Germany. The strongest instances are those of the common myrtle, pomegranate, and oleander, all of which, though European plants, perish at a temperature no way injurious to the Rhododendron ponticum of Asia Minor; this, as well as the Rhododendron maximum of North America, is much more hardy than the bay, or even than the Portugal laurel. The common laurel and bay never flower here, nor will the strawberry tree (Arbutus unedo), Aucuba japonica, Pyrus japonica, nor Buddlæa globosa of Chili, perfect their seeds. On the other hand, the Provence rose of the South of France is found every where, and the white rose (Rosa alba) is naturalized on the shores of Tyne, yet Rosa sempervirens flowers but sparingly, and the yellow rose (Rosa lutea) never flowers in the vicinity of Newcastle, but both flourish in the neighbourhood of Hexham at a distance of 30 miles from the sea; the three latter are from Germany.*

On the coast of Greece, Albania, and Dalmatia, I have observed the limestone rocks covered with the Mastic (Pistacia lentiscus) myrtle, rosemary, Laurus tinus, strawberry tree (Arbutus unedo), and juniper. Of these, the first and second will not survive our winters; the third, fourth, and fifth, will not perfect their fruit; but the last ascends to the top of our highest mountains.

I shall now briefly notice such exotic trees as succeed best with us in woods and plantations: the horse chesnut from the north of Asia, Populus dilatata from Italy, Populus balsamifera, P. monilifera, and P. angulata from North America, several of the genus Pinus and of Quercus from the same country, the larch and silver fir from the Alps, the spruce fir of the north of Europe, and some of the American ashes; but the Platanus orientalis, P. occidentalis, Liriodendron tulipifera, the cork and evergreen oaks, and cedar of Lebanon, thrive only in the most sheltered situations and best soils.

N. I. WINCH.

America, which Dr. Smith has separated from the Swiss Tofieldia, which he has named T. alpina (See Linn. Trans. vol. xii. p. 239). On the same mountainous moors, Carex capillaris, a rare Lapland and Swiss species of Sedge, is likewise met with. Cornus suecica should have been included among the Lapland plants in the former part of this paper.

* For a brief account of the Roses of the district, see Monthly Magazine, April, 1816.

ARTICLE IV.

Account of a Storm in Sussex in 1729.

THE Editors have been favoured by Sir Joseph Banks with a pamphlet, published in the year 1730, containing a narrative of a very remarkable storm, that passed over a part of the counties of Sussex and Kent, on May 20, in the preceding year. Except in its much greater degree of violence, it appears to have borne a very close resemblance to the hurricane of April 26, last, of which Col. Beaufoy has given an account, published in the last number of the *Annals;* and as the pamphlet itself, as well as the occurrence of which it treats, seem to have been nearly forgotten, they conceive that a short abstract of it may not be unacceptable to their readers.

The author, who signs himself Richard Budgen, begins by detailing the state of the weather for some days previous to May 20; after a succession of winds from a northerly point, attended by a low temperature, on the 12th; the air suddenly became much warmer, accompanied with southerly winds, and continued so until the day of the storm. The following is the account of the day itself: " The 20th, a slight flying tempest in the morning, with a little scattering rain; the rest of the day was very clear, and extremely hot and sultry; wind south till about five in the afternoon, when there began to appear a haziness in the south, which, by degrees, with a vanishing edge, arrived at our zenith about seven; when there began to appear plain symptoms of a tempest. We distinctly heard the thunder at eight, and had a prospect of two different tempests; one came over by Newhaven, Lewes, and Crowborrow, and scattered part of the shower upon us at Fraint, and Tunbridge-Wells; the other from Cuckmere-Haven, by Aldfriston, between Mayfield and Burwash, to Wadhurst, &c. About nine, these storms were passed over us into the north, and made an opening in the south-east, where we had the surprising horror of seeing (at about 20 miles distant) such unintermitting corruscations, together with such dreadful darting and breaking forth of liquid fire, at every flash of lightning (in the way of the hurricane from the sea side into Kent), as, perhaps, has not been seen in this climate for many ages."

The storm commenced its ravages at the sea side, near Bexhill, in the eastern part of Sussex, and advanced nearly in a straight line, and in a direction a little to the east of north, across the country to Newenden, in Kent: here its fury was considerably abated; it was again more violent a few miles further, but seems shortly afterwards to have been entirely dispersed. Its breadth was well defined, and comparatively limited; for the first two miles it was no more than 30 rods, but afterwards it increased to more than double that width. The distance to which it extended in its extreme violence was about 12 miles, and in this space its ravages were almost inconceivably violent; buildings of all descriptions, and many hundred trees, were instantly swept down and whirled in all directions. Its motion appears certainly to have been in a spiral direction, and from the right hand to the left, or contrary to the course of the sun; for it was observed that all bodies "drove down near the eastern verge towards the north, and near the western towards the south." With respect to its velocity, the author states that "the distance from the sea side to Newingden-Level is about 12 miles, which it passed over in 20 minutes; and if we take 70 rods for the mean diameter of the vertiginous motion, the duration of the offensive wind could not exceed 20 seconds...... According to this computation, the direct velocity of the storm is 42 feet in a second, to which adding 43 feet for the increase by the vertiginous or spiral motion, makes 85 feet; which is the space run through in every second of time near the outward verge of the gyration, and the velocity by which all obstacles received the impulse of the wind." Although it raged with so much violence in its progress along the track which it pursued, it appears to have been completely limited to this space; for in passing over woods, where it tore the largest trees into fragments, others that were in the neighbourhood suffered no injury, and "had not the least appearance of a storm by twigs or leaves blowed off;" there does not seem to have been any wind out of the direction of the hurricane; and as it proceeded across the country, its whole fury, in each particular spot, was over in perhaps half a minute. One of its most remarkable effects was that of raising up heavy bodies from the ground, and transporting them to considerable distances. In this way, large pieces of timber, and even portions of the roofs of houses, were carried many yards, and some bulky substances were entirely lost. A remarkable instance is related of this kind of transportation, where a cottage was destroyed in consequence of "a large apple tree brought out of a neighbour's orchard, over three hedges, with the roots and earth about them, that fell upon the house."

It is said that the storm generally raged with the greatest violence in gills or narrow valleys, that had a considerable declivity on each side, and upon the highest ground. Its breadth was also increased as it ascended to the tops of the hills, which gives us reason to suppose, as the author remarks, that the body of the hurricane was in the form of an inverted truncated cone; while its power of raising up heavy bodies would indicate that there was a partial vacuum in the central part of the cone, which, if it had occurred on the sea, would have produced the phenomena of a waterspout. The pamphlet contains a good deal of theoretical reasoning on the cause of the hurricane, derived from the erroneous opinions that were then prevalent; but with

Fig. 1.

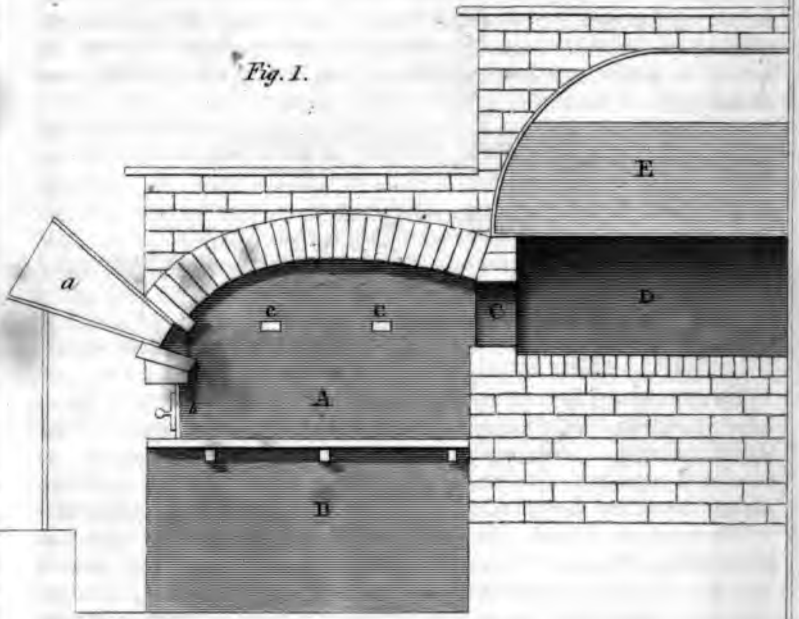
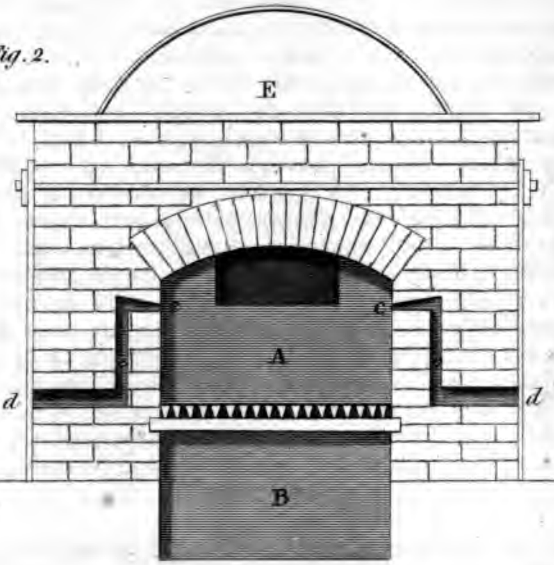


Fig. 2.



n.° & Philip Taylor J. Storey, sculp

respect to the correctness of the facts, there is strong internal evidence for placing great confidence in them. It is accompanied by an accurate map, in which the course of the hurricane is noted, and all the woods and houses marked on which it wrecked its fury.

Article V.

On the Construction of Fire-places to Steam Boilers. By John and Philip Taylor, Civil Engineers.

72, Upper White Cross-street,
May 6, 1818.

GENTLEMEN,

The annexed sketch exhibits the construction which we have lately used in the erection of fire-places to steam boilers, and which seems to combine some advantages, so as, perhaps, to render it worthy a place in your journal; at the same time we are aware that there is little in it that can be called absolutely new.

We were desirous in the first place to remove the fuel from the possibility of actual contact with the bottom of the boiler, which sometimes happens from the carelessness of the men, and still more to avoid, if possible, the injury accruing from the sudden influx of large portions of cold air from frequent opening of the fire door. The contraction caused by this sudden diminution of the heat, is apt, in some cases, to disturb the joints of the plates, where high degrees of temperature are used, and to render them leaky.

We have avoided both these evils, by removing the fire from under the bottom of the boiler, and placing it, as in the drawing, in a furnace, at one end, whence the flame reverberates through a flue passing under the vessel to be heated. As the cold air, which may at times be admitted, comes first into immediate contact with a mass of heated brickwork, and is mixed before it passes through the opening into the flue, by which the whole is, as it were, wiredrawn together, and so united as to render the changes of temperature more gradual.

The front of the furnace is provided with an inclined hopper, as shown in Plate LXXXI, which is to be kept full of coal at all times, preventing the passage of any air that way, and the fuel may be occasionally pushed forward into the furnace without much breaking through it. This mode of feeding boiler fire-places has been used before, and with advantage, and particularly where the coal is of such a quality as not to cake much, in which case it has been found that it supplies the consumption for a long time with very little trouble, and without the admission of cold air. With Newcastle coal it will not go on so regularly, but acts very well with a little assistance.

The hopper is made of cast iron; but the lower part of it, which is in contact with the fire, is terminated by Welch or Stourbridge lumps. Under it a small door is placed, which serves to permit the introduction of a bar to break up the fire occasionally, or to cut out the clinkers.

The furnace is further provided with apertures for the introduction of air, so as to consume the smoke, the situation of which may be observed in the two sections. In the lateral one may be seen where two enter the furnace on one side; the number may of course be increased at the option of the builder; and in the transverse section, the mode of conducting the air is exhibited.

It has been very judiciously observed that when cold air is admitted in a direction parallel to the current of the smoke, it frequently passes with it into the chimney without inflaming it, the two streams running as it were together without mixing in such a manner as is required to produce the effect. To have the inflammation complete, the air should be as hot as possible, by which also the least check is given to the action of the fire, and the current should cross that of the smoke where they meet, by which such a mixture of the two is produced as is required for the intended purpose.

The air in this furnace is first admitted by small passages in its sides, which are fitted with registers, and passes horizontally so as to strike against the back of the fire-bricks lining the fire-place, behind which it rises until it is turned through small apertures into the furnace. The vertical passages may be extended considerably in a lateral direction, so as to present a great heating surface to the air, which also will serve to increase the durability of the fire-bricks by keeping them cooled at the back. The air enters so as to cross the current of the draft; and the opening into the fire is so made as to direct the influx towards the centre, and to prevent it from striking the arch, which otherwise would be injured by it. The quantity of air is regulated at pleasure by the registers; and it is obvious that it will always pass into the fire in a heated state, which seems to be essential to the speedy inflammation of the smoke. We are, &c. &c.

John and Philip Taylor.

Description of the Plate.

Fig. 1. Lateral section, showing the furnace or fire-place, and one end of a long steam boiler, under which the flame passes through a semicircular flue to the chimney at the other end.

A, fire-place.
B, ash-pit.
C, throat of the furnace.
D, flue under the boiler.
E, the boiler.
a, the hopper for coals.

b, door for stoking.

c c, passages for heated air to consume the smoke.

Fig. 2. Transverse section, in which the same letters refer to the same parts as in Fig. 1.

d d, entrances for air to inflame the smoke.

e e, vertical passages behind the linings of the fire-place through which the air ascends and becomes heated.

ARTICLE VI.

Observations on the River Zaire. Collected from the Journals of Capt. Tuckey and Prof. Smith.

ALTHOUGH the first view of the river Zaire convinced the gentlemen who had undertaken to explore it, that its magnitude had been very much exaggerated, still it was found to be a considerable stream, perhaps the most so of any of the African rivers which discharge themselves into the Atlantic. The depth of the river at its mouth appears indeed to be very great, as a common sounding line of 160 fathoms did not reach the bottom; but its extreme breadth was scarcely three miles, and its velocity, concerning which such wonderful accounts had been received, was never more than five knots an hour, and often not more than two and a half. It had been asserted that the river was always in a state of full flood; and on this fact had been principally founded the hypotheses of its being the embouchure of the Niger, or at least of its extending up into the heart of the continent beyond the equator; this, however, was found to be erroneous, as during the short stay which the expedition made in the country, they observed the swell of the water distinctly to commence in the beginning of September; and from all the information which they could obtain, they were led to conclude that, with respect to its periodical floodings, it did not materially differ from the other tropical rivers. The report that its stream was so powerful as entirely to resist the effect of the tide appeared to be equally incorrect. Near the mouth of the river, its banks are low, and formed of alluvial earth; they are covered with impenetrable thickets of a luxuriant vegetation of the mangrove, and other plants of similar habits, and the stream is frequently divided into several channels by low swampy islands. The loose texture of the banks of the river causes perpetual changes in the line of the coast and the direction of the currents, and frequently small fragments of the matted turf are detached and float down the stream, with the cyperus and other gramineous plants still remaining upon them. These, which appear to have been very inconsiderable in size, were magnified by the Portuguese into floating islands, torn off from the main land by the violence of the torrent, and suspended by its velocity. Beyond the alluvial ground, the country rises into rounded hills of moderate height, which are represented as being generally barren, and the whole district seems to be but thinly peopled. On account of the difficulty of the navigation, depending partly upon the irregularity of the sea breezes, which were scarcely sufficient to counteract the force of the stream, and still more from the winding and uncertain course of the bed of the river, the large vessel proceeded only as far as Embomma, a slave mart belonging to the Portuguese, which is the principal settlement in the country, about 80 or 90 miles from the sea. For a distance of 50 or 60 miles further, the river still continues to be navigable, but it is considerably contracted in its dimensions, and the hills approach so near to each other, as in some places to leave only narrow strips of soil, and in others, to come to the water's edge. They are described as bare and rocky, chiefly composed of mica slate, with masses of quartz rising above the surface. In the little valleys between the hills, there is more of the appearance of fertility; but the whole district appears to have been barren and uninteresting. The climate is represented as pleasant, the thermometer seldom exceeding 76° in the day, or descending below 60° in the night; the atmosphere was generally serene, and the diurnal changes uniform. In the morning there are light breezes from the S.; and for some hours in the middle of the day or afternoon, there is a regular sea breeze.

The dreariness of the country increased as the travellers advanced into the interior. Capt. Tuckey remarks, "the most striking features of the country are the extreme barrenness of the hills near the river, the whole being still composed of slate with masses of quartz and sienite, the latter becoming the main formation, as we advanced to the S.E. with perpendicular fissures from three inches to one quarter inch in breadth filled with quartz." The bed of the river continues to contract in its dimensions, and all navigation, even for canoes, becomes at length impracticable, and remains so for about 40 miles. The water was here not more than from 300 to 500 yards broad; its current necessarily becomes rapid, is broken into whirlpools by rocks, while the banks are in many parts almost perpendicular, and rise up to a great height. Besides a succession of smaller rapids, there is a larger one in this part, which is spoken of by the natives as a prodigious cataract. When the travellers saw it, which, however, was just before the commencement of the rainy season, "they were not less surprised than disappointed, instead of a second Niagara, which the description of the natives, and their horror of it, had given us reason to expect, to find a comparative brook bubbling over its stony bed." Perhaps in the flooded state of the river, this rapid, which is called the fall of Yellala may correspond more nearly with the description which the natives gave of it. At all times, however, it is quite sufficient to put an entire stop to all navigation; and besides this particular obstacle, the stream is, in this part of its course, full of eddies and whirlpools, and in some places darts along with very great velocity. The fall of Yellala is formed by a succession of ridges of micaceous slate, that cross the stream in an oblique direction; the rocks on both sides the fall are very steep, and the mica slate, which is here undulating, abounds with veins of quartz and compact feldspar.

After passing this long, rocky defile, the river again expands to a breadth nearly equal to that of its mouth, the banks become picturesque and beautifully varied, assuming the appearance of a succession of lakes, while the country itself seemed to be much improved in fertility. It is remarkable that from the mouth up to this point, the Zaire does not receive a single branch of the least consequence. Here the labours of the party terminated; and respecting the source of the Zaire, we are left entirely to conjecture, as the reports that they were able to collect from the natives were perfectly vague, and not in the least to be depended upon. As to the hypothesis of the Zaire being the continuation of the Niger, we confess that the general impression produced on our minds is completely adverse to it; for although the Zaire, as it passes through the kingdom of Congo, is a river of considerable magnitude, it appears in the higest degree improbable that the stream which Park saw at Sego should not have received a greater accession after travelling some hundreds of miles. If the expedition to Congo can be considered as throwing any light upon the curious problem of the termination of the Niger, we should be disposed to say that it has done so, in as much as it proved this river not to be identical with the Zaire.

Article VII.

*Morphium and Meconic Acid.**

In the number of the *Annals* for June, 1817, we gave some account of the properties of the first of these substances, to which we shall now add a few more particulars. Many chemists had endeavoured to analyze opium, and M. Derosne, whose account appeared in vol. xlv. of the Ann. de Chimie, was supposed to have detected the principle on which its specific properties depend. By a succession of solutions, crystallizations, and distillations, he procured a crystallizable body, which appeared to form a proximate principle of the opium, and to be in an uncombined state, to which he gave the name of the essential salt of opium. It possessed the narcotic properties of this substance in a high degree, and in its chemical relations partook of the nature of a resin.

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* Abridged from Ann. de Chim. t. v. and Journal de Pharm. for Oct. 1817.

The examination of opium has been more lately undertaken by M. Sertuerner, and the results of his experiments have been considerably different from those of M. Derosne, or rather he has carried his researches to a greater degree of minuteness, so as to have detected in opium what seem to be two new vegetable principles, one the morphium, which possesses many characters of an alkali, the other, a new vegetable acid, to which he gives the name of the meconic acid. To procure morphium, the extract of opium is digested in acetic acid, or even in warm water, ammonia is added in excess, and the morphium is precipitated. It is, however, united to a quantity of extract and meconic acid, to deprive it of which it is dissolved in diluted sulphuric acid, and again precipitated by ammonia; it may be still further purified by alcohol. For the leading characters of morphium and its combinations with the acids, we shall refer our readers to the account which we have already given of it, and shall now proceed to the meconic acid. This substance was entirely overlooked by M. Derosne in his examination of opium; M. Sertuerner procured it by the following process. After precipitating the morphium from a solution of opium by ammonia, he adds to the residual fluid a solution of the muriate of barytes; a precipitate is in this way formed which is conceived to be a quadruple compound of barytes, morphium, extract, and the meconic acid. The extract is removed by alcohol, and the barytes by sulphuric acid, when the meconic acid is left merely in combination with a portion of the morphium, and from this it is purified by successive solutions and evaporations. The acid when sublimed forms long colourless needles; it has a strong affinity for the oxide of iron, so as to take it from the muriatic solution, and form with it a cherry-red precipitate; it also forms a crystallizable salt with lime, which is not decomposed by sulphuric acid; and what is of importance, it seems to possess no particular power over the body when received into the stomach. The essential salt of opium obtained by M. Derosne is conceived to have been the meconate of morphium, i. e. a compound of the two new principles contained in opium.

The two new substances have been examined by M. Robiquet and M. Vogel. M. Robiquet, in order to discover whether the morphium owed any of its peculiar characters to a portion of ammonia still adhering to it, substituted magnesia for the ammonia; but he procured morphium by this process of the same nature as in the former; it exhibited an equally, or even a more decisive alkaline character. M. Robiquet employed a more effectual method of procuring the meconic acid than that employed by Sertuerner; it consisted essentially in treating the opium with magnesia, in order to extract the morphium, when the meconate of magnesia is formed at the same time. The magnesia is removed by adding the muriate of barytes, and the barytes is afterwards removed by diluted sulphuric acid. The operation is more complicated than the one employed by M. Sertuerner, but the meconic acid is procured in much larger proportion.

The meconic acid is stated to be very soluble both in alcohol and in water; it does not seem to precipitate the oxides of iron as M. Sertuerner conceived, although it gives a bright red colour to the solutions of iron, nor does it appear to form combinations with the oxides of copper or mercury; but with potash, soda, and lime, it forms crystallizable salts. M. Robiquet, in opposition to the opinion of M. Sertuener, conceives that the salt obtained by M. Derosne is not the meconate of morphium; but he does not inform us what is the constitution of this substance.

M. Vogel observes that morphium may be obtained in larger quantity if the opium be dissolved in acetic acid than in water, and finds that it possesses the same properties whatever alkali or alkaline earth we employ for its precipitation. He obtained the meconic acid by precipitating the residual fluid after the removal of the opium by the nitrate of barytes; it was then digested with alcohol, and afterwards treated with diluted sulphuric acid. Brown crystals are deposited, consisting of the acid in an impure state; they may be purified by sublimation, but the quantity thus procured is very small; it may be obtained more copiously by dissolving them in hot water and causing them to crystallize a second time. The power which the meconic acid possesses of reddening the solutions of iron is so great as to render it even a more delicate test for this metal than the prussiate of potash.

Upon the whole there seems no reason to doubt the general correctness of M. Sertuerner's results, that opium contains two peculiar vegetable principles; that one of them is of an alkaline and the other of an acid nature, and that the former is the body which is the vehicle of the narcotic part of this substance. The only circumstance that seems to be wanting to remove all doubt respecting so remarkable a fact as that of the discovery of a new alkali, is that the alkali or alkaline earth, which is employed in the process, should be afterwards completely recovered or accounted for, so as to remove all doubt respecting the possibility of a portion of it still adhering to the morphium and giving it its supposed alkaline properties.

Article VIII.

On softening Steel by heating and quenching it, and on the hardening and tempering it at one Operation. By Thomas Gill, Esq.

(To the Editors of the *Annals of Philosophy.*)

No. 11, *Covent Garden Chambers,*
June 15, 1818.

GENTLEMEN,

I have now the pleasure of communicating for insertion in your *Annals,* the above two processes on steel; and which, to artisans in general, may seem to be impossibilities, being so very different to the general practices; but which, nevertheless, can be readily performed under proper management, and possess very considerable advantages over the ordinary methods.

It is well known that unless steel be heated to the proper degree, it will not harden on being quenched in water, or other proper fluid; but it has escaped the general observation, *that steel heated rather below the hardening point and quenched will be softened thereby,* and in a much superior manner than by the usual methods of annealing it, insomuch that it can be more readily filed, turned, &c. and is entirely free from pins or hard spots; and as it is not at all liable to be injured by this process, and can be softened thereby in a much shorter time than by annealing it, so it ought to be universally adopted.

Steel springs are usually hardened and tempered by two distinct operations, being first heated to the proper degree, and hardened by quenching in water, oil, &c. and then tempered, either by rubbing them bright and heating them till they acquire a pale blue or grey colour, or by burning or blazing off the oil, &c.

It is, however, now found that both operations may be advantageously performed at once, in the following manner:

The steel being heated to the proper degree, is to be plunged into a metallic bath composed of a mixture of lead and tin, such for instance as plumbers' solder, and which is heated by a proper furnace, to the tempering degree, as indicated by a pyrometer or thermometer placed in the bath, *when the steel will be at once hardened and tempered,* and with much less danger of warping or cracking in the process than if treated in the usual way.

It would be a further improvement to heat the steel in a bath of red-hot lead to the proper degree for hardening, previous to quenching and tempering it in the other metallic bath, as it would thereby be more uniformly heated, and be in less danger of oxidation; and, indeed, it is an excellent method of heating steel, either for softening it, as in the first described process, or for hardening and tempering it at once, as in the last mentioned one, or even for hardening it in the usual method.

Hoping these suggestions will lead to the improvement of the articles made of steel, and that they may also induce other persons, who may be possessed of processes not generally known, to communicate them through your channel for the public good,

I have the pleasure to remain, Gentlemen,
Your most obedient servant,
THOMAS GILL.

ARTICLE IX.

History of Dr. Brewster's Kaleidoscope, with Remarks on its supposed Resemblance to other Combinations of plain Mirrors. From a Correspondent.*

As this instrument has excited great attention, both in this country and on the Continent, the readers of the *Annals* will doubtless take some interest in the history of the invention. In the year 1814, when Dr. Brewster was engaged in experiments on the polarization of light by successive reflections between plates of glass, which were published in the Phil. Trans. for 1815, and honoured by the Royal Society of London with the Copley medal, the reflectors were in some cases inclined to each other, and he had occasion to remark the circular arrangement of the images of a candle round a centre, or the multiplication of the sectors formed by the extremities of the glass plates. In repeating, at a subsequent period, the experiments of M. Biot on the action of fluids upon light, Dr. B. placed the fluids in a trough formed by two plates of glass cemented together at an angle. The eye being necessarily placed at one end, some of the cement which had been pressed through between the plates appeared to be arranged into a regular figure. The symmetry of this figure being very remarkable, Dr. B. set himself to investigate the cause of the phenomenon; and in doing this he discovered the leading principles of the kaleidoscope. He found that in order to produce perfectly beautiful and symmetrical forms, three conditions were necessary.

1. That the reflectors should be placed at an angle, which

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* In the last number of the *Annals* (p. 451), we inserted some remarks upon the kaleidoscope, more especially concerning its discovery by Dr. Brewster, and the circumstances in which it essentially differs from those instruments that have been supposed to bear a general resemblance to it. The subject is so generally interesting, that we do not hesitate to present to our readers a second and more extended communication on the same topic, in which the history of the discovery is more minutely traced, and the differences more fully detailed between the kaleidoscope and the apparatus described by Bradley. We have omitted the letter from Prof. Playfair to Dr. Brewster, as it had already appeared in the *Annals*, retaining only the postcript; and we have also curtailed the article in some other parts, which seemed of less importance.

was an *even* or an *odd* aliquot part of a circle, when the object was regular; or the *even* aliquot part of a circle when the object was irregular.

2. That out of an infinite number of positions for the object both within and without the reflectors, there was *only one* position where perfect symmetry could be obtained, namely, by placing the object in contact with the ends of the reflectors.

3. That out of an infinite number of positions of the eye, there was *only one* where the symmetry was perfect, namely, as near as possible to the angular point, so that the circular field could be distinctly seen; and that this point was the *only one* out of an infinite number at which the uniformity of the light of the circular field was a maximum.

Upon these principles Dr. B. constructed an instrument, in which he fixed *permanently* across the ends of reflectors pieces of coloured glass, and other irregular objects, and he showed the instrument in this state to some members of the Royal Society of Edinburgh, who were much struck with the beauty of its effects. In this case, however, the forms were nearly permanent, and a slight variation was produced by varying the position of the instrument, with respect to the light. The great step, however, towards the completion of the instrument remained yet to be made; and it was not till some time afterwards that the idea occurred to Dr. B. *of giving motion to objects, such as pieces of coloured glass, &c. which were either fixed or placed loosely in a cell at the end of the instrument.* When this idea was carried into execution, the kaleidoscope, in its *simple form,* was completed.

In this state, however, the kaleidoscope could not be considered as a general philosophical instrument of universal application; for it was incapable of producing beautiful forms unless the object was nearly in perfect contact with the end of the reflectors.

The next, and by far the most important step of the invention, was therefore to remove this limitation by employing a draw tube and lens, by means of which beautiful forms could be created from objects of all sizes, and at all distances from the observer. In this way the power of the kaleidoscope was indefinitely extended, and every object in nature could be introduced into the picture in the same manner as if these objects had been reduced in size, and actually placed at the end of the reflectors.

When the instrument was brought to this state of perfection, Dr. Brewster was urged by his friends to secure the exclusive property of it by a patent; and he accordingly took out a patent for "A New Optical Instrument for creating and exhibiting beautiful Forms." In the specification of his patent he describes the kaleidoscope in two different forms. The first consists of reflecting planes, put together according to the principles described, and placed in a tube, with an eye-hole in the position which gives symmetry and a maximum uni- light, and with objects such as coloured glass, *placed* *in the position of symmetry, and put in motion either by a rotatory movement, or by their own gravity, or by both combined.* The second form of the instrument, described in the specification, is when the tube containing the reflectors is placed in a second tube, at the end of which is a convex lens which introduces into the picture objects of all magnitudes, and at every distance, as has been already described.

After the patent was signed, and the instruments in a state of forwardness, the gentleman who was employed to manufacture them under the patent, carried a kaleidoscope to show to the principal London opticians, for the purpose of taking orders from them. These gentlemen naturally made one for their own use, and for the amusement of their friends; and the character of the instrument being thus made public, the tinmen and glaziers began to manufacture the detached parts of it, in order to evade the patent; while others manufactured and sold the instrument complete, without being aware that the exclusive property of it had been secured by a patent.

In this way the invasion of the patent right became general among that class of individuals against whom the law is seldom enforced but in its terrors. Some workmen of a higher class were encouraged to piracy by this universal opposition to the patent; but none of the respectable London opticians would yield to the clamours of their customers, to encroach upon the rights of an inventor, to whom they were at least indebted for a new and a lucrative article of trade.

In order to justify these piratical proceedings, it became necessary to search out some combinations of plain mirrors, which might be supposed to have some resemblance to Dr. Brewster's instrument; and it would have been strange indeed if some theorem or experiment had not been discovered, which could have been used to impose upon the great crowd who are entirely ignorant of the principles and construction of optical instruments. There never was a popular invention which the labours of envious individuals did not attempt to trace to some remote period; and in the present case so many persons had hazarded their fortunes and their characters, that it became necessary to lay hold of something which could be construed into an anticipation of the kaleidoscope.

The first supposed anticipation of the kaleidoscope was found in Prop. XIII. and XIV. of Professor Wood's Optics, where that learned author gives a mathematical investigation of the number and arrangement of the images formed by two reflectors, either inclined or parallel to each other. This theorem assigns no position either to the eye or to the object, and does not even include the principle of inversion, which is absolutely necessary to the production of symmetrical forms. The theorem is true, whatever be the position of the object or of the eye. In order to put this matter to rest, Dr. Brewster wrote a letter to Professor

Wood, requesting him to say if he had any idea of the effects of the kaleidoscope when he wrote those propositions. To this letter Dr. B. received the following handsome and satisfactory answer:

"*St. John's, May* 19, 1818.

"Sir,—The propositions I have given relating to the number of images formed by plane reflectors inclined to each other, contain merely the mathematical calculation of their number and arrangement. *The effects produced by the kaleidoscope were never in my contemplation.* My attention has for some years been turned to other subjects, and I regret that I have not time to read your Optical Treatise, which I am sure would give me great pleasure. I am, Sir, your obedient humble servant,

"J. WOOD."

The next supposed anticipation of the kaleidoscope was an instrument proposed by Mr. Bradley in 1717. This instrument consists of two large pieces of silvered looking-glass, *five inches wide* and *four inches high*, jointed together with hinges, and opening like a book. These plates being set upon a geometrical drawing, and the eye being placed in front of the mirrors, the lines of the drawing were seen multiplied by repeated reflections. This instrument was described long before by Kircher, and did not receive a single improvement from the hands of Bradley. It has been often made by the opticians, and was principally used for multiplying the human face, when placed between the mirrors; but no person ever thought of applying it to any purpose of utility, or of using it as an instrument of rational amusement, by the creation of beautiful forms. From the very construction of the instrument, indeed, it is quite incapable of producing any of the singular effects exhibited by the kaleidoscope. It gives, indeed, a series of reflected images arranged round a centre, but so does a pair of looking-glasses placed angularly in an apartment, and so do the pieces of mirror glass with which jewellers multiply the wares exhibited at their windows. It might, therefore, be as gravely maintained that any of these combinations of mirrors was a kaleidoscope, as that Bradley's pair of plates was an anticipation of that instrument. As the similarity between the two has been maintained by ignorant and interested individuals, we shall be at some pains to explain to the reader the differences between these two instruments, and we shall do this, first, upon the supposition that the two instruments are applied to geometrical lines upon paper.

1. In Bradley's instrument, the length is less than the breadth of the plates	1. In the kaleidoscope, the length of the plates must be four, or five, or six times their breadth.
2. Bradley's instrument can be used with a [illegible]	2. The kaleidoscope cannot be used without a tube

3. In Bradley's instrument, from the erroneous position of the eye, there is a great inequality of light in the sectors, and the last sectors are scarcely visible.	3. In the kaleidoscope, the eye is placed so that the uniformity of light is a maximum, and the last sectors are distinctly visible.
4. In Bradley's instrument, the figure consists of elliptical, and consequently unequal sectors.	4. In the kaleidoscope, all the sectors are equal, and compose a perfect circle, and the picture is perfectly symmetrical.
5. In Bradley's instrument, the unequal sectors *do not unite*, but are all separated from one another by a space equal to the thickness of the mirror glass.	5. In the kaleidoscope, the equal sectors all unite into a complete and perfectly symmetrical figure.
6. In Bradley's instrument, the images reflected from the first surface interfere with those reflected from the second, and produce a confusion and overlapping of images entirely inconsistent with symmetry.	6. In the kaleidoscope, the secondary reflections are entirely removed, and therefore no confusion takes place.
7. In Bradley's instrument, the defects in the junction of the plates are all rendered visible by the erroneous position of the eye.	7. In the kaleidoscope, the eye is placed so that these defects of junction are invisible.

The reader will observe, that in this comparison the two instruments are supposed to be applied to *geometric lines upon paper*, and that this was *the only purpose* to which Bradley ever thought of applying his mirrors; yet the kaleidoscope is in every respect a superior instrument, even for that inferior purpose, and gives true symmetrical forms, which the other instrument is incapable of doing.

In the comparison which has now been made, we have degraded the kaleidoscope by contrasting its effects with those which Bradley's instrument is capable of producing, for these effects are not worth the looking at. When we attempt to employ Bradley's instrument to produce the effects which have been so much admired in the kaleidoscope, namely, to produce beautiful forms from transparent or opaque-coloured objects contained in a cell, and at the end of the reflectors it fails so entirely that no person has succeeded in the attempt. It is indeed quite impossible to produce by it the beautiful and symmetrical forms which the kaleidoscope displays. Had this been possible, Dr. Brewster's patent might have been invaded with impunity by every person who chose to manufacture Bradley's instrument; but this was never tried,* and for the best of all reasons, because nobody would have purchased it.

We trust that no person, who wishes to judge of this subject with candour, will form an opinion without having *actually seen and used* the instrument proposed by Bradley. Let any person take Bradley's plates, and, having set them at an angle of 30° or 22½°, place them upon a cell containing fragments of coloured glass, he will infallibly find that he cannot produce a picture of any symmetry or beauty. The disunion of the sectors, the darkness of the last reflections, and the enormous deviation from symmetry, towards the centre of the figure, will convince him, if he required conviction, that the instrument is entirely useless as a kaleidoscope. To those, however, who are not capable, either for want of knowledge or want of time, to make such a comparison, we may present the opinion of three of the most eminent natural philosophers of the present day, viz. the celebrated Mr. Watt, Professor Playfair, and Professor Pictet.

"It has been said here," says Mr. Watt, "that you took the idea of the kaleidoscope from an old book on gardening. My friend, the Rev. Mr. Corrie, has procured me a sight of the book. It is Bradley's Improvements of Planting and Gardening. London 1731, part 2, chap. i. It consists of two pieces of looking glass of equal bigness, of the figure of a long square, five inches long and four inches high, hinged together, upon one of the narrow sides, so as to open and shut like the leaves of a book, which, being set upon their edges upon a drawing, will show it multiplied by repeated reflections. This instrument I have seen in my father's possession 70 years ago, and frequently since; but what has become of it I know not. In my opinion, the application of the principle is very different from that of your kaleidoscope."

Postcsript to Prof. Playfair's Letter. (*For the Letter itself, see Annals*, xi. 451.)

"P. S.—Granting that there were a resemblance between the kaleidoscope and Bradley's instrument, in any of the particulars mentioned above, the introduction of coloured and moveable objects, at the end of the reflectors, is quite peculiar to Dr. Brewster's instrument. Besides this, a circumstance highly deserving of attention, is the use of two lenses and a draw tube, so that the action of the kaleidoscope is extended to objects of all sizes, and at all distances from the observer, and united, by that means, to the advantages of the telescope. J. P."

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* In illustration of this argument, we may state the following fact. Mr. C. of Birmingham, being anxious to evade Dr. Brewster's patent, at a time when the manufacture of the patent kaleidoscope was in the hands of another person, attempted to construct instruments in imitation of Bradley's. After exercising his ingenuity for some time, he abandoned the attempt as impracticable, and set off for Scotland for the purpose of offering his services in manufacturing the patent instrument.

Professor Pictet's opinion is stated in the following letter:

"Sir,—Among your friends, I have not been one of the least painfully affected by the shameful invasion of your rights as an inventor, which I have been a witness of lately in London. Not only none of the allegations of the invaders of your patent, grounded on a pretended similarity between your kaleidoscope and Bradley's instrument, or such as Wood's or Harris's theories might have suggested, appear to me to have any real foundation; but I can affirm that neither in any of the French, German, or Italian authors, who, to my knowledge, have treated of optics, nor in Professor Charles's justly celebrated and most complete collection of optical instruments at Paris, have I read or seen any thing resembling your ingenious apparatus, which, from its numberless applications, and the pleasure it affords, and will continue to afford, to millions of beholders of its matchless effects, may be ranked among the most happy inventions science ever presented to the lovers of rational enjoyment.

"M. A. Pictet,
Professor of Nat. Phil. in the
Academy of Geneva."

"*To Dr. Brewster.*"

The propositions in Harris's Optics relate, like Professor Wood's, merely to the multiplication and circular arrangement of the apertures or sectors formed by the inclined mirrors, and to the progress of a ray of light reflected between two inclined or parallel mirrors; and no allusion whatever is made, in the propositions themselves, to any instrument. In the proposition respecting the multiplication of the sectors, the eye of the observer is never once mentioned, and the proposition is true if the eye has an infinite number of positions; whereas, in the kaleidoscope, the eye can only have one position. In the other proposition (Prop. XVII.) respecting the progress of the rays, the eye and the object are actually stated to be placed *between the reflectors;* and even if the eye had been placed without the reflectors, as in the kaleidoscope, the position assigned it, at a great distance from the angular point, is a demonstration that Harris was *entirely ignorant of the positions of symmetry either for the object or the eye,* and could not have combined two reflectors so as to form a kaleidoscope for producing beautiful or symmetrical forms. The *only practical part* of Harris's propositions is the fifth and sixth scholia to Prop. XVII. In the fifth scholium he proposes a sort of catoptric box or cistula, known long before his time, composed of four mirrors, arranged in a most unscientific manner, and containing opaque objects *between the speculums.* "Whatever they are," says he, when speaking of the objects, "the upright figures between the speculums should be slender, and not too many in number, otherwise they will too much *obstruct the reflected rays from coming* to the eye." This shows, in a most decisive manner, that Harris knew nothing of the kaleidoscope, and that he has not even improved the common catoptric cistula, which had been known long before. The principle of inversion, and the positions of symmetry, were entirely unknown to him. In the sixth scholium, he speaks of rooms lined with looking-glasses, and of luminous amphitheatres, which, as the Editor of the Literary Journal observes, have been described and figured by all the old writers on optics.*

The persons who have pretended to compare Dr. Brewster's kaleidoscope with the combinations of plain mirrors described by preceding authors, have not only been utterly unacquainted with the principles of optics, but have not been at the trouble either of understanding the principles on which the patent kaleidoscope is constructed, or of examining the construction of the instrument itself. Because it contains two plain mirrors, they infer that it must be the same as every other instrument that contains two plain mirrors, and hence the same persons would, by a similar process of reasoning, have concluded that a telescope is a microscope, or that a pair of spectacles with a double lens is the same as a telescope or a microscope, because all these instruments contain two lenses. An astronomical telescope differs from a compound microscope only in having the lenses placed at different distances. The progress of the rays is exactly the same in both these instruments, and the effect in both is produced by the enlargement of the angle subtended by the object. Yet surely there is no person so senseless as to deny that he who first combined two lenses in such a manner as to discover the mountains of the moon, the satellites of Jupiter and Saturn, and all the wonders of the system of the universe, was the author of an original invention. He who produces effects which were never produced before, even by means which have been long known, is unquestionably an original inventor; and upon this principle alone can the telescope be considered as an invention different from the microscope. In the case of the kaleidoscope, the originality of the invention is far more striking. Every person admits that effects are produced by Dr. Brewster's instrument, of which no conception could have been previously formed.

All those who saw it, acknowledged that they had never seen any thing resembling it before; and those very persons who had been possessors of Bradley's instrument, who had read Harris's Optics, and who had used other combinations of plain mirrors, never supposed for a moment, that the pleasure which they derived from the kaleidoscope had any relation to the effects described by those authors.

No proof of the originality of the kaleidoscope could be stronger than the sensation which it created in London and

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* The reader is requested to examine carefully the propositions in Harris's Optics, which he will find reprinted in the Literary Journal, No. 10. He will then be convinced that Harris places both the eye and the object between the mirrors, an arrangement which was known 100 years before his time.

Paris. In the memory of man, no invention, and no work, whether addressed to the imagination or to the understanding, ever produced such an effect. A universal mania for the instrument seized all classes, from the lowest to the highest, from the most ignorant to the most learned, and every person not only felt, but expressed the feeling, that a new pleasure had been added to their existence.

If such an instrument had ever been known before, a similar sensation must have been excited, and it would not have been left to the ingenuity of the half learned and the half honest to search for the skeleton of the invention among the rubbish of the 16th and 17th centuries.

ARTICLE X.

Proceedings of Philosophical Societies.

ROYAL SOCIETY.

May 28.—A paper, by John Pond, Esq. Astronomer Royal, was read, on the parallax of the fixed stars in right ascension. The author stated that this paper was an appendix to a former one on the same subject. He divides the results of his observations upon certain stars into two parts, according as they were made what he calls incidentally or according what is termed the law of parallax; and as no greater difference was observable in the latter than in the former case, it is concluded that the parallax is not so considerable as to be sensible.

A paper, by Mr. Donovan, was also read, on the oxides and salts of mercury.

Mr. Donovan commences by giving a view of what had been done by preceding chemists on this subject, and afterwards relates his own experiments. He thinks the protoxide of mercury consists of 100 parts of mercury to 4·12 parts of oxygen; while the peroxide consists of 100 parts of mercury to 7·82 parts of oxygen. These he supposes to be the only oxides of mercury, the one corresponding to the black, the other to the red.

June 4.—A paper, by Sir Ev. Home, Bart. V.P.R.S. was read, containing an account of the teeth of the delphinus gangeticus; also a paper, by T. Smith, Esq. on the structure of the poisonous fangs of serpents.

A paper was also read, by A. B. Granville, M.D. on sulphureted azote, a substance which he supposes to be the produce of a peculiar process of animal decomposition, which takes place in the living body. It existed as a component part of a gas which was found in the abdomen, and was mixed with a portion of carbonic acid. It was supposed to be composed of 89½ parts of azote and 10½ of sulphur.

A paper was also read containing an account of some experiments made to ascertain the effects of voltaic electricity upon vegetable life, by J. Williams, Esq.

June 11.—A paper, by Dr. Prout, was read, on a new acid principle prepared from lithic or uric acid. The beautiful purple substance produced by the action of nitric acid and heat upon lithic acid has been long known to chemists. This substance Dr. P. has shown to be a compound of a peculiar acid with ammonia.

This acid principle, which may be likewise formed from the lithic acid by chlorine and iodine, possesses the remarkable property of forming beautiful purple compounds with the alkalies and alkaline earths; hence the name of *purpuric* acid has been adopted by Dr. P. which was suggested by Dr. Wollaston.

Purpuric acid may be separated from the purpuret of ammonia, before mentioned, by the sulphuric or muriatic acids. It usually exists in the form of a light yellow or cream-coloured powder. It is exceedingly insoluble in water, and consequently possesses no taste, nor affects litmus paper, though it readily decomposes the alkaline carbonates by the assistance of heat. It is soluble in the strong mineral acids and in alkaline solutions, but not in dilute acids in general. In alcohol, it is insoluble. When exposed to the air, it assumes a purple colour, probably by attracting ammonia. Submitted to heat, it is decomposed, and yields carbonate of ammonia, prussic acid, and a little fluid of an oily appearance. Burned with the oxide of copper, it was found to consist of

Hydrogen...........	4·54
Carbon..............	27·27
Oxygen.............	36·36
Azote..............	31·81

The alkaline purpurates, as before observed, all form solutions of a beautiful purple colour. They are capable of crystallizing; and their crystals possess some remarkable properties. The purpurate of ammonia crystallizes in quadrangular prisms, which, when viewed by transmitted light, appear of a deep garnet red; but by reflected light, two of the opposite surfaces appear of a beautiful green, while the other two opposite surfaces appear of the natural colour. This curious property seems to be possessed by the other alkaline purpurates. The metallic purpurates are, in general, remarkable for their solubility and the beauty of their colours. The purpurate of zinc is of a beautiful gold yellow, the purpurate of tin of a pearly white, that of the other purpurates are more or less of a red colour.

Dr. P. thinks it probable that this acid forms the basis of many animal and vegetable colours. The pink colour of the sediment in the urine of fever seems to be owing to the purpurate of ammonia. Dr. P. also thinks that some of its salts might be used as paints, and also for dyeing, as they appear to possess strong affinities, especially for animal substances.

A paper, by Sir W. Herschell, was also read, entitled astronomical observations and experiments selected for the purpose of ascertaining the relative distance of clusters of stars; and of investigating how far the power of our telescopes may be expected to reach into space when directed to ambiguous celestial objects.

GEOLOGICAL SOCIETY.

March 6.—A paper was read, entitled "Observations on the Valleys and Watercourses of Shropshire, and of Parts of the adjacent Counties," by Arthur Aikin, Esq.

From the heights of parts of the line of the Ellesmere canal, and from other data, Mr. A. computes the summit level of the tract which separates the valley of the Dee from that of the Severn, to be about 295 feet above the Dee at Chester; and the height of the Severn at Shrewsbury to be about 155 feet above the Dee at Chester.

The descent of the Severn from Llanidloes to the sea appears to be at the rate of 11 feet per mile for the first 20 miles, not navigable; then three feet eight inches per mile for 26 miles; one foot eight inches per mile for 21 miles, and from Worcester to Gloucester, about 30 miles, only four inches per mile.

From a variety of observations on the course of the Severn, Mr. A. concludes that the navigation of a river is very precarious, and liable to long and frequent interruptions, even in a rainy climate, when the descent of the stream exceeds three feet per mile, and that the highest floods run off in a few hours, even when the descent amounts to two feet six inches in the same space.

The descent of the Dee from Llandysilio to Pont y cysyllte, a distance of six miles, is at the rate of 22 feet per mile; and thence to Chester, amounts to about five feet one inch per mile.

The heights of water-sheds, or sources of rivers, being important points in physical geography, Mr. Aikin recommends the subject to the notice of such members of the Society as may be enabled to supply information concerning it.

April 3.—A paper was read, from Dr. Brewster, on the form of the integrant molecule of carbonate of lime.

Dr. B. has discovered that the striæ passing through the long diagonals of two opposite planes of the primitive rhomboid of carbonate of lime are occasioned by their traversing veins composed of rhomboids of different thicknesses, having their faces placed transversely to those of the rhomboid which they traverse, and adhering firmly to the two surfaces between which they are interposed. Dr. B. rests the proof of this fact on the action which the surface of the crystal exerts on a ray of light. He concludes that the integrant molecule is not a trihedral prism, as Count Bournon supposed, since the transverse cleavage of the primitive rhomboid exists only in those specimens which are *crossed by intersecting veins.*

A paper was read from A. S. Lillingston, Esq. on granite veins and whin dykes, in which he explains these appearances on the supposition that the beds containing the veins were deposited upon the mass of which the vein is a portion, while that mass was in a fluid state; and that the deposited beds were the first to become hard, in consequence of which they contracted, thus occasioning fissures which were subsequently filled by the subjacent fluid mass.

The author also supposes the red marl stratum to have been produced from the destruction of beds of whin stone, fragments of which abound in it, as may be observed in Devonshire, Northumberland, and other places.

A letter was read, from the Rev. W. Gilpin, on certain fossil bones found near Margate. These bones, in the state of fragments, occur in the hard, white, calcareous clay which overlies the extremity of the chalk cliff extending along the coast to the westward of Margate. The bones lie at least 10 or 12 feet below the surface, and are surrounded by a dark, friable substance, similar to decayed animal matter.

April 17.—A second paper was read, from George Cumberland, Esq. on some new encrinital and pentacrinital bodies found in the nighbourhood of Bristol. It affords much interesting and curious information concerning the class of bodies of which it treats, but which cannot conveniently be detached from the illustrative series of drawings by which it is accompanied.

May 1.—A paper was read, from George Cumberland, Esq. consisting of a descriptive catalogue of specimens of the Bristol limestone beds, from their transition from the sandstone to their termination, at a place called Cook's Folly, nearly the whole of which Mr. Cumberland has measured. The series consists of above 300 beds, from one inch to 30 feet in thickness.

A paper was read, from Francis Lunn, Esq. on the strata of the northern division of Cambridgeshire.

Mr. Lunn observes that the ferruginous sand is the lowest stratum found in Cambridgeshire; on this rests the blue marl, having in many places the line of their junction very well defined: the sand contiguous to the clay is generally cemented by a large portion of oxide of iron into a hard, rocky substance. The sand contains fossil wood; the clay contains carbonate and sulphate of barytes. The temperature of the water in all the wells sunk through the clay, is about 47° Fahrenheit, and is nearly invariable throughout the year.

May 15.—The following notices were communicated by M. Leman, M.G.S. through Mr. Heuland, For. Sec.

On Mica.—M. Biot has lately divided this mineral into two species. When submitted to the action of polarized light, the coloured rings which are produced are traversed in the first species by two axes in the form of a black cross; and in the *second species* by a second axis or black band, passing through their centre. The surfaces of the first species are smooth and brilliant, while those of the second are dull and finely furrowed. M. Vauquelin has found a difference in the chemical constituents of the two species. Crystallography appears to admit as the primitive form of mica either a right or an oblique rhombic prism. Is it not probable that these may be the respective primitive forms of the two species?

On Wallerite, or Linzinite.—Dr. Dufour, of St. Sever, Dept. des Landes, has lately discovered near that place, in a bed of clay, a substance externally resembling lithomarga. It appears, however, from an analysis of it by M. Laugier, to contain

Silex	32
Alumine	37
Water.	27
Sulphate of lime.	3
	99

It may, therefore, be considered as a siliceous hydrate of alumine.

LINNÆAN SOCIETY.

May 5.—A continuation of the Rev. Mr. Kirby's century of new insects was read.

May 25.—The following is the list of officers for the ensuing year.

President.—Sir James Edward Smith, M.D.

Vice Presidents.—Samuel Lord Bishop of Carlisle; Aylmer Bourke Lambert, Esq.; William George Maton, M.D.; Edward Lord Stanley.

Of the Council, in Place of five Members who go out.—John Duke of Bedford; Mr. Andrew Forster; Thomas Andrew Knight, Esq.; Thomas Reynolds, Esq.; Sir George Thomas Staunton, Bart.

Treasurer.—Edward Forster, Esq.

Secretary.—Alexander M'Leay, Esq.

Under Secretary.—Mr. Richard Taylor.

June 2.—A paper was read, by Capt. Carmichael, on the genus pandanus.

June 16.—A letter was read, addressed to the Rev. Mr. Kirby by the Rev. Revett Sheppard, on the position of the toes in certain genera of birds.

The woodpecker tribe have four toes on each foot, two before and two behind, which arrangement, according to Ray and all subsequent naturalists, is for the purpose of enabling them to climb with facility. According to Mr. Sheppard, there are six genera of birds *pedibus scansoriis*, viz. psittacus, cuculus, picus, rhamphastus, trogon, and bucco.

The common cuckoo, which is one of these, though furnished with two toes before and two behind, is never known to climb at all; *while the* nuthatch (sitta europea) and tree creeper (certhia familiaris) have their toes placed in the usual manner, viz. three before and one behind, and yet run up and down trees with great facility. From these and similar cases Mr. S. considers the *pes scansorius* as intended not for climbing, but for secure prehension; and hence it is found in the woodpecker and others which, having to procure their food by penetrating the wood with their strong bills, require a firm footing, which is effected by the arrangement of their toes as already stated.

Article XI.

SCIENTIFIC INTELLIGENCE, AND NOTICES OF SUBJECTS CONNECTED WITH SCIENCE.

I. *Attempts to penetrate into the Interior of Africa.*

In the Journal of Science and the Arts, v. 146, we have the following account, which we believe is the only authentic document, that has yet been published, of the unfortunate termination of the expedition under Major Peddie.

" A letter from Sierra Leone mentions the return to that place of the scientific expedition for exploring the interior of Africa. They were completely unsuccessful, having advanced only about 150 miles into the interior from Rio Nunez. Their progress was then stopped by a chief of the country; and after unavailing endeavours, for the space of four months, to obtain liberty to proceed, they abandoned the enterprize and returned. Nearly all the animals perished. Several officers died, and but one private, besides one drowned, of about 200. Captain Campbell died two days after their return to Rio Nunez, and was buried in the same spot where Major Peddie and one of his officers were buried on their advance."

Our expectation of penetrating into the interior of Africa has received a still more cruel disappointment in the death of that intrepid and adventurous traveller Burckhardt, which took place on October 15, last, at Cairo. He had resided nearly eight years in Egypt and Syria, and had diligently occupied himself in exploring these countries, and in making himself thoroughly acquainted with the language, manners, and religious ceremonies of the Arabs. He had so far attained this object as to have adopted their dress and costume, and under the denomination of Sheich Ibrahim, had effectually concealed his European origin. Having completed all his preliminary arrangements, he was anxiously waiting for the arrival of a caravan from Mourzouk, which he proposed to accompany on its return, when he was seized with an attack of dysentery, which in ten days terminated fatally.

This succession of disappointments has not, however, repressed the ardour of adventure, and we learn that Mr. Ritchie, late private secretary to Sir Charles Stuart, has undertaken to reach the Niger and Tombuctoo by a new route, which seems indeed to hold out peculiar advantages. The present Bashaw of Tripoli has intimated his readiness to co-operate with the British government in the promotion of their plans; Fezzan is a dependency of Tripoli, and is at this time governed by a Bey, who is the son of the Bashaw; and it appears that there is a constant communication between Fezzan and Kashna, Bournou, and even Tombuctoo itself. It seems that the French are likewise turning their attention to the same object, and that the traveller Bahdia, who is so well known under his assumed name of Ali Bey, is now entering upon an expedition, which is stated to be nearly the same with that which had been projected by Burckhardt.

II. *On Pargasite.*

(To the Editors of the *Annals of Philosophy.*)

GENTLEMEN,

The *new* mineral, of which you have given a short notice in the last number of the *Annals* under the name of *pargasite*, has been known in this country three or four years, and was described by the Abbé Haüy in vol. i. of the "Memoires du Museum d'Histoire Naturelle," published in 1815; he found the crystalline form of many of the grains, and the cleavage, similar to those of hornblende; of which mineral he considered it a variety. He says he observed in some of the grains traces of a dihedral summit, and these traces have probably led the author of the description you have copied to regard the form of the substance as an octohedron; a form which would obviously result from a very short prism with the dihedral termination. The relative proportions of the component parts of hornblende differ considerably in the different analyses which have been published. But the presence of fluoric acid does not appear to have been noticed before.

I am, Gentlemen, yours, &c. F. J.

N. B. Has not Capt. Hall mistaken some of the molluscæ for polypes in the description you quote of the coral reefs, observed by him near the island of Loo-Choo?

III. *On Mr. Tritton's distilling Apparatus.*

(To the Editors of the *Annals of Philosophy.*)

GENTLEMEN,

You have inserted in the last number of the *Annals* an account of the apparatus contrived by Mr. Tritton for distilling in vacuo; the attempt, although not new, is specious; and when the method is recommended by so respectable a philosopher as Mr. Allen, it is extremely probable that it will, to a certain extent, meet with the patronage of the public. I had prepared some remarks to show that the employment of the apparatus in question must necessarily end in disappointment; I shall, however, content myself with merely sending you for insertion in the *Annals* the following extract from vol. i. p. 190, of Dr. Black's

Lectures; in which it will appear that this illustrious philosopher and his eminent friend Mr. Watt, are theoretically and experimentally inimical to distilling in vacuo.

Your constant reader, P. A.

Mr. Watt "finds that water distils perfectly well, when of the temperature 70°, and that, in this state, the latent heat of the steam approaches to 1,300, and certainly exceeds 1,200. The unexpected result of these experiments, is, that there is no advantage to be expected in the manufacture of ardent spirits by distilling in vacuo; for we find that the latent heat of the steam is at least as much increased as the sensible heat is diminished. This will undoubtedly be attended with an increased expenditure of fuel; for the increase of 100 degrees of sensible heat occasions an increase of fuel only while we are raising the temperature of the still to the ordinary heat of boiling water, in the beginning of the distillation. If the furnace be judiciously constructed, and due precautions taken to prevent dissipation, it requires very little fuel to maintain this temperature. But 100 degrees of latent heat is an expense that is continual, and which no contrivance whatever can prevent."

On the subject of Mr. Tritton's method of distilling in vacuo, the Editors beg to remark, that this gentleman does not, in his letter, state the saving of fuel as an advantage likely to arise from his process, but merely the improved quality of the fluid, as being free from the unpleasant flavour which is apt to attach to spirits distilled at a high temperature. The experiments on the oils contained in different species of corn, mentioned at p. 35 of this number, may probably throw some light upon the point in question.

IV. *Newly discovered Membrane in the Eye.*

Dr. Jacob, Demonstrator of Anatomy in the University of Dublin, has discovered, and demonstrated in his lectures on the diseases of the eye, this spring, a membrane covering the external surface of the retina, in man and other animals. Its extreme delicacy accounts for its not having been hitherto noticed. He arrived at the discovery by means of a new method of displaying and examining this and other delicate parts. He argues from analogy the necessity of the existence of such a membrane, as parts so different in structure and functions as the retina and choroid coat must otherwise be in contact, in contradiction to the provisions of the animal economy in general. A detailed account of the discovery, with the method of displaying the membrane, is in preparation, and will shortly be laid before the public.

V. *Plate presented to Dr. Paris.*

On Tuesday the 16th instant, a deputation of noblemen and gentlemen, of the county of Cornwall, waited upon Dr. Paris, at his house in Dover-street, with a magnificent present of plate for his acceptance. The inscription, which is engraved on a massy silver waiter, records the services for which it was given. "To John Ayrton Paris, M.D. F.L.S. Fellow of the Royal College of Physicians of London, this plate is inscribed by the noblemen, representatives in Parliament, and gentlemen of the county of Cornwall, in testimony of their grateful sense of his services, in originating the plan, and promoting the institution of the Royal Geological Society of the county, which has rendered their home the school of science, and their native riches increasing sources of prosperity."

VI. *On the Spiral Oar.* By James Boaz, Esq.

(To Dr. Thomson.)

SIR, *Glasgow, June* 8, 1818.

In your *Annals of Philosophy* for this month, I see a paper signed by Mr. T. L. Dick, stating that Mr. Scott, of Ormiston, had shown him a drawing of a spiral oar for propelling a vessel. As I consider this kind of oar may be brought to do much good in that way, I beg leave to state that the same occurred to me on August 12, 1804, which was the day after I had been foiled in an experiment by another method for propelling a small boat (on the Hugginfield Loch) used at building the wooden bridge over the Clyde here. I soon after made a model of a boat on a small scale, with two strong clock springs in one barrel, to drive a train of wheels, which wrought one of these spiral oars inside of a double keel at the bottom of the vessel, having gratings to prevent weeds from getting foul of the oar. I tried various sorts of spiral, some with the thread very close, others more sparse, and a few with two, three, and even four threads. I was best pleased with that having a double thread and moderate angle, as the motion of the model in the water at an experiment, Nov. 2, 1804, was at the rate of from four and a half to five miles per hour. This, if necessary, I can produce credible witnesses to testify. Whether the idea was new on August 12, 1804, I know not—it was so to me.

A spiral has since, under my direction, been successfully applied to force hot air into a cold apartment where there was power to spare for driving it; and I have often thought that the principle, if properly executed on a large scale, might in some cases be used for ventilating coal and other mines so as to free them of dangerous gases. Your obedient servant,

JAMES BOAZ.

VII. *A new Metal.*

We are informed that Prof. Stromeyer, in examining the sublimate which concretes in the chimnies of the zinc furnaces of Saxony (and which has long been known to chemists by the name of *Cadmia fornacum*), has discovered a new metal, to which he has given the name of *Cadmium*. Of this we hope to be able to give a further account in our next number.

Article XII.

Astronomical, Magnetical, and Meteorological Observations.

By Col. Beaufoy, F.R.S.

Bushey Heath, near Stanmore.

Latitude 51° 37′ 42″ North. Longitude west in time 1′ 20·7″.

Astronomical Observations.

May 4. Solar eclipse	Beginning	17h 53′ 55″	Mean Time at Bushey.
	End.....	19 41 17	
May 19. Immersion of Jupiter's second satellite		13h 09′ 31″	Mean Time at Bushey.
		13 10 51·7	Mean Time at Greenwich.

Magnetical Observations, 1818. — *Variation West.*

Month.	Morning Observ.		Noon Observ.		Evening Observ.	
	Hour.	Variation.	Hour.	Variation.	Hour.	Variation.
May 1	8h 40′	24° 36′ 11″	1h 15′	24° 45′ 33″	7h 15′	24° 38′ 25″
2	8 15	24 32 50	1 15	24 44 49	— —	— — —
3	8 40	24 34 06	1 20	24 45 46	— —	— — —
4	8 30	24 33 30	1 25	24 46 12	7 15	24 36 46
5	8 25	24 36 06	1 20	24 44 06	7 15	24 38 51
6	8 30	24 35 56	1 10	24 45 10	7 10	24 37 30
7	8 35	24 35 46	— —	— — —	— —	— — —
8	8 40	24 37 17	1 20	24 48 03	— —	— — —
9	8 35	24 36 26	1 20	24 50 27	7 15	24 35 16
10	8 35	24 35 18	1 50	24 45 30	7 20	24 38 14
11	8 25	24 35 53	1 25	24 45 08	7 20	24 38 40
12	8 30	24 36 00	1 15	24 45 40	7 20	24 36 50
13	8 40	24 36 27	1 20	24 46 09	7 25	24 37 50
14	8 20	24 34 15	— —	— — —	7 40	24 39 34
15	8 40	24 39 41	1 15	24 47 37	7 30	24 38 54
16	8 25	24 40 29	1 40	24 42 15	7 15	24 34 53
17	8 40	24 34 55	1 25	24 44 42	7 20	24 38 13
18	8 20	24 41 14	— —	— — —	7 35	24 40 28
19	8 40	24 36 18	1 35	24 44 36	7 25	24 38 13
20	8 25	24 36 26	1 30	24 46 48	— —	— — —
21	8 30	24 37 28	1 25	24 48 42	7 25	24 38 36
22	8 25	24 37 16	1 30	24 46 31	7 30	24 40 26
23	8 30	24 36 01	1 25	24 46 13	— —	— — —
24	8 30	24 34 58	1 30	24 45 40	7 30	24 39 44
25	8 30	24 36 19	1 25	24 44 54	7 35	24 40 10
26	8 30	24 34 23	1 20	24 43 23	7 30	24 41 46
27	8 25	24 34 49	1 15	24 44 57	7 30	24 38 58
28	8 25	24 34 42	1 25	24 44 33	7 30	24 38 00
29	8 30	24 43 50	1 25	24 47 27	7 25	24 39 54
30	8 30	24 35 49	1 25	24 46 13	7 25	24 38 03
31	8 25	24 34 48	1 45	24 45 44	7 25	24 40 24
Mean for Month.	8 30	24 36 18	1 24	24 45 49	7 24	24 38 35

Rain, by the pluviameter, between noon on May 1, and noon the 1st of June, 2·455 inches. Evaporation, during the same *period, 3·77 inches.*

Meteorological Observations.

Month.	Time.	Barom.	Ther.	Hyg.	Wind.	Velocity.	Weather.	Six's.
May		Inches.				Feet.		
1	Morn....	29·300	53°	54°	SW by S		Showery	47°
	Noon....	29·363	57	44	SW by W		Showery	58
	Even	29·445	50	47	SSW		Clear	
2	Morn....	29·430	51	47	ESE		Cloudy	43
	Noon....	29·375	57	43	Var.		Showery	53
	Even	—	—	—	—		—	
3	Morn....	29·070	51	83	ENE		Sm. rain	43
	Noon....	29·053	60	57	ESE		Fine	62½
	Even	—	—	—	—		—	
4	Morn....	29·065	51	50	W		Very fine	46½
	Noon....	29·083	62	40	Var.		Fine	64
	Even	29·090	57	—	Calm		Fine	
5	Morn....	29·025	52	49	N		Very fine	49
	Noon....	29·000	59	41	Var.		Cloudy	62
	Even	28·970	55	49	E		Thunder	
6	Morn....	28·905	52	60	ENE		Cloudy	49
	Noon....	28·890	59	49	SSW		Rain, thund.	61½
	Even	28·885	52	54	S		Fine	
7	Morn....	28·900	51	60	SW		Cloudy	48
	Noon....	—	—	—	—		—	59
	Even	—	—	—	—		—	
8	Morn....	29·113	53	51	SSE		Fine	46
	Noon....	29·113	60	38	SSE		Fine	63½
	Even	29 005	—	50	E		Rain	
9	Morn....	29·123	53	51	SW by S.		Fine	45½
	Noon....	29·158	58	46	SSW		Showery	60
	Even	29·220	52	50	SSW		Fine	
10	Morn....	29·418	51	41	SSW		Very fine	44
	Noon....	29·418	57	42	Var.		Showery	60
	Even	29·400	52	48	S by W		Fine.	
11	Morn....	29·285	54	49	S		Fine.	45
	Noon....	29·240	62	39	SSW		Fine	63
	Even	29·200	55	45	S by W		Cloudy	
12	Morn....	29·200	53	50	W		Fine	49½
	Noon....	29·213	58	39	W		Cloudy	60
	Even	29·235	55	41	W by S		Fine	
13	Morn....	29·000	49	65	ESE		Rain	45
	Noon....	28·930	57	48	SW by S		Showery	58
	Even	28·953	50	50	SW by S		Fine	
14	Morn....	28·930	51	54	S		Showery	43
	Noon....	—	—	—	—		—	—
	Even	29·054	49	56	SE by S		Fine	
15	Morn....	29·090	53	51	Var.		Cloudy	45½
	Noon....	29·070	53	42	NW		Cloudy	61
	Even	29·085	53	47	ENE		Fine	
16	Morn....	29·122	51	56	W by N		Cloudy	43
	Noon....	29·137	57	44	WNW		Showery	59½
	Even	29·190	53	51	W by N		Cloudy	
17	Morn....	29·243	58	74	NW		Rain	50
	Noon....	29·271	54	70	NE		Rain	55
	Even	29·330	53	68	NE		Cloudy	
18	Morn....	29·455	52	54	NNW		Very fine	45
	Noon....	—	—	—	—		—	66
	Even	29·510	53	47	NNE		Fine	

Meteorological Observations continued.

Month.	Time.	Barom.	Ther.	Hyg.	Wind.	Velocity.	Weather.	Six's.
May		Inches.				Feet.		
19	Morn....	29·550	49°	62°	NE by N		Cloudy	45°
	Noon....	29·565	55	53	NE by N		Cloudy	56
	Even....	29·570	49	60	NE by N		Cloudy	41
20	Morn....	29·615	49	49	NE by N		Very fine	
	Noon....	29·623	60	36	E by N		Very fine	62½
	Even....	—	—	—	—		—	45
21	Morn...	29·733	49	50	ENE		Cloudy	
	Noon....	29·750	56	38	NE by E		Very fine	58
	Even....	29·735	49	41	E by N		Clear	38
22	Morn....	29·773	48	48	ENE		Fine	
	Noon....	29·790	57	38	E by N		Very fine	59
	Even....	29·810	52	44	E		Clear	41½
23	Morn....	29·873	50	48	ENE		Fine	
	Noon....	29·862	57	40	ENE	5·894	Very fine	60
	Even ...	—	—	—	—		—	41
24	Morn....	29·900	52	54	E by N		Fine	
	Noon....	29·900	61	37	E	11·163	Clear	62½
	Even....	29·890	55	39	E		Clear	46
25	Morn....	29·895	51	57	ENE		Cloudy	
	Noon....	29·865	60	44	ENE	7·255	Fine	63
	Even....	29·835	55	45	E by N		Clear	45
26	Morn....	29·837	55	51	ENE		Very fine	
	Noon....	29·820	66	33	E	7·033	Clear	66½
	Even....	29·823	57	35	E		Clear	44½
27	Morn....	29·883	52	51	NE		Very fine	
	Noon....	29·867	63	42	NE	5·103	Very fine	64
	Even....	29·827	62	41	NNE		Clear	42
28	Morn....	29·772	53	45	NNE		Clear	
	Noon....	29·760	65	32	NNE	—	Very fine	66
	Even....	29·720	50	42	NE		Fine	44
29	Morn....	29·673	51	42	NE by N		Cloudy	
	Noon....	29·673	57	35	N by E	—	Fine	69
	Even....	29·670	52	37	N		Fine	43
30	Morn....	29·685	48	42	NNE		Cloudy	
	Noon....	29·652	57	39	NNE	3·604	Fine	59½
	Even....	29·610	48	43	E		Fine	45½
31	Morn....	29·542	55	47	NW by W		Very fine	
	Noon....	29·530	68	31	N	—	Fine	71
	Even....	29·530	56	50	Var.		Showery	

ARTICLE XIII.

METEOROLOGICAL TABLE.

1818.	Wind.	BAROMETER.			THERMOMETER.			Hygr. at 9 a. m.	Rain.	
		Max.	Min.	Med.	Max.	Min.	Med.			
4th Mon.										
April 28	S W	29·98	29·80	29·890	53	30	41·5	53		
29	N E	29·98	29·75	29·865	65	41	53·0	50		
30	Var.	29·88	29·75	29·815	53	48	50·5	70	51	
5th Mon.										
May 1	S W	29·88	29·70	29·790	60	35	47·5	56	5	
2	Var.	29·85	29·45	29·650	69	47	58·0	52	39	
3	S W	29·48	29·36	29·420	66	43	54·5	75	3	
4	N W	29·48	29·40	29·440	67	42	54·5	58		
5	N E	29·40	29·26	29·330	65	48	56·5	62	18	●
6	N E	29·26	29·22	29·240	65	45	55·0	72	31	
7	S W	29·51	29·26	29·385	62	43	52·5	63	—	
8	S	29·51	29·40	29·455	65	44	54·5		1·46	
9	S W	29·84	29·51	29·675	60	45	52·5		2	
10	S W	29·84	29·67	29·755	64	37	50·5	50	—	
11	S	29·67	29·57	29·620	67	49	58·0	43	2	
12	N W	29·63	29·45	29·540	66	40	53·0	44	15	
13	S E	29·45	29·30	29·375	61	41	51·0	59	10	☽
14	S	29·47	29·30	29·385	58	39	48·5	57	1	
15	N W	29·52	29·47	29·495	63	41	52·0	46	—	
16	N	29·65	29·52	29·585	63	50	56·5	45	5	
17	N W	29·87	29·65	29·760	61	44	52·5	75		
18	N	30·00	29·87	29·935	69	47	58·0			
19	N E	30·05	30·00	30·025	57	38	47·5			
20	E	30·20	30·05	30·125	65	45	55·0			○
21	E	30·23	30·20	30·215	59	36	47·5			
22	E	30·32	30·23	30·275	61	42	51·5			
23	N E	30·35	30·32	30·335	61	37	49·0			
24	S E	30·35	30·25	30·300	63	44	53·5			
25	N E	30·26	30·25	30·255	65	40	52·5			
26	N E	30·33	30·23	30·280	69	42	55·5			☾
		30·35	29·22	29·766	69	30	52·84	57	3·28	

The observations in each line of the table apply to a period of twenty-four hours, beginning at 9 A. M. on the day indicated in the first column. A dash denotes, that the result is included in the next following observation.

REMARKS.

Fourth Month.—28. Much dew: at nine a. m. a brisk wind carrying *Cumuli*, above which appeared beds of *Cirrus* and *Cirrocumulus*, moving from SE: a fine day ensued, with *Cumulostratus*. 29. Fine. 30. Overcast early, with the wind NE; after which wet till evening.

Fifth Month.—1. A fine day, save a shower or two. 2. Large *Cumuli* rose, which in the E especially mingled and inosculated with *Cirrostratus* above; I suspected thunder in that direction: at sunset, *Cirri* from N to S, above *Cirrostrati* ranging E and W: rain by night. 3. Drizzling, a. m.: fine, with *Cumulus*, and *Cirrus* at mid-day: in the evening, heavy showers appeared to the N and NE, with much *Cirrostratus* overhead. 4. Very fine, with *Cumuli*, and large, plumose *Cirri* stretching E and W; the clouds, though heavy, dispersed at sunset. 5. Sunshine at six a. m. with a few *Cirri*, &c.: before seven, a sudden mist came on from the E and NE, which obscured the view of the *Solar Eclipse* during the middle half hour of the time; the dew lay on the grass till noon, in the sunshine, and large *Cumuli* formed, inosculating with the clouds above: at two p. m. some heavy showers fell, but so local, that the road, half a mile off to the S, remained dusty: in the evening, *Nimbi* appeared in thunder-groups to the SE and S, and, finally, more extensive rain came on, with the wind SE. 6. Rain, a. m., and at night.

RESULTS.

Winds Variable.

Barometer:	Greatest height	30·35 inches;
	Least	29·22 inches;
	Mean of the period	29·766 inches.
Thermometer:	Greatest height	69°
	Least	30°
	Mean of the period	52·84°
Hygrometer (mean of 18 days)		57°
Evaporation		1·70 inches.
Rain		3·28 inches,

being, as usual of late, about double the average quantity.

Having left home on a journey on the morning of the 8th ult. I did not witness a very uncommon fall of rain which took place in this neighbourhood. It commenced early in the evening of that day, and lasted about 12 hours. Near an inch and a half of water descended in the above space of time, which, taking the shortest course from the higher ground to the hollows, filled the latter several feet deep, and overflowed the roads, in several places not usually subject to this accident. Much inconvenience, and some loss of property, ensued, the particulars of which were detailed in the papers of the subsequent days. This heavy rain seems to have been connected with a change in the general current, which, after a few days further continuance of unsettled weather, became established from the northward, the barometer assuming a high level, and the earth drying rapidly. It was, indeed, a singular spectacle to behold the ground saturated with water, and every spring running up to so late a period in the season as the middle of the fifth month, when our fields are commonly dry enough, in every situation, to admit of the soil being pulverised by the harrows.

Tottenham, *Sixth Month*, 17, 1818. L. HOWARD.

ANNALS

OF

PHILOSOPHY.

AUGUST, 1818.

ARTICLE I.

Biographical Sketch of Charles Augustin Coulomb.[*]

CHARLES AUGUSTIN COULOMB was born at Angoulême, on June 14, 1736, and was a member of a family that had been distinguished for their public services in the town of Montpelier. He came to Paris when very young, and soon manifested a decided taste for mathematics; but various circumstances having prevented him from pursuing this branch of science, he embraced the profession of a military engineer. In this capacity he spent about nine years in the West Indies; he prosecuted his employment with much ardour, and had the active superintendence of many important public works; but from the exertions which he made, together with the unhealthiness of the climate, he experienced such unfavourable effects upon his constitution, that it was necessary for him to return to Europe.

From this time Coulomb devoted himself almost entirely to philosophical pursuits, directing his attention principally to the mechanical sciences, or employing himself in elucidating them by mathematical reasoning. He presented to the Academy, from time to time, memoirs on various topics connected with practical mechanics; soon after his return from America, which was in the year 1779, he divided with Van Swinden the prize proposed for the best construction of the mariner's compass, and two years afterwards had the prize awarded him for his paper on the theory of simple machines. One of the most important topics which he discusses in this valuable memoir is that of friction; he examined the opinions of those who had already treated upon it; he repeated and varied their experiments; and proceeding upon a larger scale, he obtained results which were in many respects novel, and altogether very interesting. Some of the most curious observations which he made were respecting the relation between the length of time in which the effect of friction reaches its maximum quantity, and the amount of the weight or force employed. This relation he found to be of the greatest importance in a practical point of view, and to influence the results so materially, that unless it is taken into account, all our calculations must be fundamentally erroneous. For example, supposing that the force required to overcome the friction of one surface upon another, as depending upon a certain pressure on the surface, when the bodies were first placed in contact, was 100, in a few seconds it would be as 250 or 300, and in a few days it would increase to 900 or 1000.[*]

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[*] The facts in this biographical sketch are principally taken from the eloge by M. Cuvier, Mem. Inst. 6.

In the researches to which he was led in his experiments on the construction of the compass, he had occasion to pay particular attention to the effects of what he stiles torsion, or the resistance which the suspending wire opposes to the action of the needle, in obeying the magnetic attraction. This circumstance was the cause of Coulomb's invention of what he denominated his torsion balance, an instrument which he afterwards employed very extensively for measuring minute forces, such as those produced by extremely small quantities of electricity and magnetism. An account of his experiments on this subject was published in the memoirs of the Academy of Sciences for 1784, under the title of theoretical and experimental researches on the force of torsion, and the elasticity of metallic threads. The action of the torsion balance essentially consists in the resistance which an extremely fine thread opposes to our attempts to twist it, and his object was to obtain an accurate measure of the force of this resistance. The nature and construction of the instrument are too well known to require any minute description; it may be stated, in general terms, as consisting of a metallic wire, which is fixed at its upper end and is suspended in a vertical direction, while to its lower end is attached a cylinder connected with a horizontal index; by causing the arms of the cylinder to revolve upon the point of suspension, the wire to which it is attached is twisted; and when we cease to twist it, its elasticity causes it to assume its natural position. The index in this case will pass through a certain space which is measured by a graduated scale.[†] Coulomb's experiments led him to conclude that the force with which the wire endeavours to regain its natural position is in the direct ratio of the distance to which it has been removed from it; and hence, when we obtain the measure of the distance, we have that of the force. The power which operates upon the wire is called the force of torsion; and the angle formed by the index in its natural position, and that to which it is brought by the operation of the twisting power, is called the angle of torsion. This is accurately measured on the scale; and assuming that the force of torsion is equal to the angle of torsion, we are able to ascertain this force with the most perfect accuracy. Proceeding upon this principle, a number of experiments were performed with a view to ascertain the action of different wires, so far as respected their length, their thickness, and the nature of the materials of which they were composed; and he deduced from them a series of propositions which afford very important data for estimating the amount of very minute, attractive and repulsive forces.[*]

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[*] Mem. Sçav. Etrang. x. 163. The prize was awarded in 1781, and the paper printed in 1784.

[†] A figure of the torsion balance may be found in the Supplement to the Enc. Brit. Pl. 27, figures 1, 2, 3, 4, 5, also in Dr. Brewster's Encyc. Art. Electricity, Pl. 244, fig. 7, 8, 9, 10.

Coulomb had been elected a member of the Academy in 1781, and now made Paris his residence, devoting himself for some years almost exclusively to the investigation of the sciences of electricity and magnetism, more especially in endeavouring to perfect their theory. In this investigation he was materially assisted by his torsion balance, and was enabled, by means of it, to execute some very delicate experiments, which may be considered as forming the basis of his most important speculations. He proved by it that electrical attractions and repulsions follow the general law of the inverse ratio of the squares of the distances, a law which had been assumed by preceding philosophers as highly probable, and as agreeing generally with the phenomena, but which had not before obtained the sanction of direct experimental proof. In the further prosecution of his researches on the subject of electricity, Coulomb was induced to adopt the hypothesis of the two electric fluids, which had been originally proposed by Dufay, and supported by Symmer, but which, at least in this country, had been almost unanimously renounced for the more simple doctrine, which attributes all the effects to the excess or defect of a single fluid. Every one must admit that he defends his hypothesis with much ability, and even with the precision of mathematical reasoning; but we must recollect that the whole is founded upon a gratuitous assumption, and that we are not entitled to employ the agency of two fluids in our explanations, until we have found it impossible to explain the phenomena by the supposition of a single fluid. If, therefore, the theories are equally plausible, we shall be obliged to reject the one which proceeds upon the assumption of the greater number of hypothetical principles.

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[*] Coulomb's essay on torsion is in the ninth volume of the Mem. Sçav. Etrang. and is entitled, "Researches theoretical and experimental on the Force of Torsion, and on the Elasticity of metallic Threads; Application of this Theory to the Employment of Metals in the Arts and in different philosophical Experiments; Construction of different Torsion Balances, for the Purpose of measuring very small Degrees of Force; Observations on the Laws of Elasticity and of Cohesion." His general theorem is as follows: that the momentum of the force of torsion is, for threads of the same kind of metal, in the compound ratio of the angle of torsion, the fourth power of the diameter, and the inverse ratio of the length of the thread; so that if we call the angle of torsion B, the diameter D, and the length l, we shall have as the expression which represents the force of torsion $\frac{\mu B D^4}{l}$, where μ is a constant coefficient, which depends upon the natural stiffness of every metal; this quantity μ, which is invariable for the threads of each particular metal, may be easily determined by experiment.

In the science of magnetism, upon which Coulomb bestowed a great share of attention, we may observe the same tendency to assume imaginary data, upon which, however, he reasons with much precision, and from which he derives a beautiful and consistent theory. In order to explain the action of the magnet, he supposes that all the particles of the instrument are so many partial magnets, having their opposite poles in contact. The operation of these poles will, in a great measure, be neutralized by each other, so that the two extreme poles only will be in a state of activity. This hypothesis, like the one on electricity, he defended with much ingenuity, and he showed that it was adequate to explain all the phenomena, but, like the former, it rests upon a gratuitous foundation. Besides his hypotheses, he, however, made some important observations on magnetism, especially those that refer to the effects produced upon it by temperature. He found that the magnetic property of the needle is diminished as its temperature is increased, and that probably, at a certain high temperature, it would be entirely destroyed; this degree was too high to be ascertained by direct experiment; but by employing a theorem of Laplace, it was estimated at the 700° on the centigrade scale, or about 1,450° of Fahrenheit. By means of the delicate sensibility of his torsion balance, Coulomb conceived that he was able to detect the magnetic property in many bodies which were not suspected to contain iron, and was finally induced to form the conjecture, that magnetism, like electricity, may exist in all bodies, though it is frequently contained in them in a latent state, and requires a particular combination of circumstances for its development. This idea appears, however, to have been brought forwards rather as a speculation, which might be confirmed or refuted by future experiments, than as forming a part of his matured theory, and is contrary to the opinions that are generally entertained upon the subject. The experiments and researches of Coulomb on electricity and magnetism were more directed to the establishment or elucidation of his hypotheses than to the development of any new facts; so that, although he devoted so much of his attention to these departments, he has produced in either of them very little of what can properly be considered as discoveries. So far as our information extends, the torsion balance of

Coulomb has been very little employed in this country, and even in France its use appears to have been principally confined to the author himself, so that its value still rests, in a great measure, upon his authority.[*]

Among the other objects to which Coulomb directed his attention, we must not omit to mention a memoir which was published by the Academy in the year 1781 on wind-mills, in which the author made a great number of experiments on the mills near Lisle, particularly directing his attention to the form of the sails, and the quantity of effect which they were able to produce by a given force of the wind. A very curious and elaborate paper of Coulomb was published in the Memoirs of the Institute for the year 1798, detailing numerous experiments on the quantity of power which a man can exert in the course of a day, and on the best method of employing his strength. The author inquires what weight can be best borne during a certain number of hours, how many loads, and of what size, can be carried along a horizontal surface; and how many by the same person mounting up steps: he afterwards examines the comparative force employed in performing many of the common operations of labourers, such as pulling a rope, turning a winch, &c. and endeavours to form accurate estimates on all these points. We think it doubtful whether all the calculations and deductions contained in this paper, although derived from experiments, which were doubtless made with much care and diligence, are applicable to any useful purposes; so many circumstances, besides those of a mere mechanical nature, are concerned; and even the mechanical powers of different individuals depend so much upon causes which are difficult to detect and impossible to appreciate. In the year 1800, Coulomb published, in the Memoirs of the Institute, a paper on magnetism, and likewise one of his most learned essays on the cohesion of fluids. He employed his torsion balance in the experimental part of the inquiry; and he was led by his experiments to form the conclusion, that the resistance which fluids oppose to the slow motion of their particles upon each other is represented by two terms, the one proportional to the velocity of the motion, the other to the square of this velocity.*

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[*] Coulomb published, in the whole, seven memoirs on electricity, which are contained in the Memoirs of the Academy for the years 1785, 1786, 1787, 1788, and 1789. The following may be regarded as among the most important of the propositions which compose his hypothesis of electricity:

1. There exist two electric fluids, one vitreous, and the other resinous.
2. The particles of each of these fluids repel each other.
3. The particles of one of these fluids attract the particles of the other fluid.
4. These attractions and repulsions are in the inverse ratio of the square of the distance.
5. The electric fluid does not diffuse itself through different bodies in consequence of a chemical affinity, but it is distributed among them when placed in contact, according to their figure or position, solely by its repulsive force.
6. In conductors, the electric fluid diffuses itself entirely along the surface, without penetrating into the interior.
7. In electrics, the fluid penetrates into the interior of the body.
8. The electric force is not produced by impulse, nor by the action of any extraneous impulsive fluid.
9. The electric fluid does not form active atmospheres around bodies, by the particles of which the phenomena of attraction and repulsion are produced, but they depend upon the action of the fluid in the body itself.
10. When electricity is excited by friction, or by any other means, the two bodies acquire different kinds of electricity, the one vitreous, and the other resinous.

Coulomb supposed the cause of magnetism to be very analogous to that of electricity; that there were two magnetic fluids; that their particles repel each other; that the particles of one fluid attract the particles of the other; that they act in the inverse ratio of the squares of the distances; but that the fluid is lodged entirely in the interior of the body.

The events of Coulomb's life are few, and not particularly interesting. The French revolution deprived him of some offices which he had filled under the monarchy, and probably impaired his private property. At the dissolution of the Academy he felt no longer any interest in the metropolis, nor indeed could it be considered as a place of security for any one distinguished either for talents or for acquisitions of a more incidental kind. He retired for some time to a small estate which he possessed near Blois, until the violence of the storm was passed over, when he was recalled to take his place in the Institute, of which he continued ever after to be an active member. His death took place in his 70th year, in consequence of a gradual exhaustion of the nervous system, the immediate result of a febrile attack, but probably originating in the decay of the system incident to the decline of life.

The moral character of Coulomb is stated by his eulogist to be of a high order of excellence; he is said not only to have possessed many great virtues, but to have had few defects to counterbalance them. It is indeed admitted that he had an impatience of temper, which he often found it difficult to restrain; but this seems not to have been carried to such a degree as to render him unamiable, or to disqualify him for any of the relations of society. The scientific reputation of Coulomb has been highly estimated by those who are the best qualified to judge of his merits; his mathematical learning was unquestionably very profound; and all his writings indicate a clear and correct method of reasoning, united to a comprehensive view of his subject. Upon the whole, however, we think it is to be regretted that he devoted himself so much to the formation of hypotheses; and we cannot but regard him as having expended upon refined speculations a large portion of the ability and exertions which probably might have been more usefully bestowed upon the acquisition of real knowledge.

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* The following are the titles of the papers published by Coulomb in the Memoirs of the Institute:

V. 2. Experiments on the Circulation of the Sap in Trees.

V. 2. Results of Experiments to determine the Quantity of Power which can be exerted by Men in their daily Labour, according to the Mode in which they employ their Strength.

V. 3. Theoretical and experimental Determination of the Forces which bring different magnetic Needles to Saturation at their magnetic Meridian.

V. 3. Experiments to determine the Cohesion of Fluids, and the Laws of their Resistance in very slow Motions.

V. 4. New Method of determining the Inclination of the Magnet.

V. 6. Results of the different Methods employed to give Plates and Bars of Steel the greatest Degree of Magnetism.

ARTICLE II.

On the injurious Effect of burying Weeds. By Mrs. Ibbetson.

(To the Editors of the *Annals of Philosophy.*)

GENTLEMEN, *May* 30, 1818.

To establish facts upon the sure and solid foundation of repeated experiments, and to discard all those that are derived from hasty conjecture, and which have not been regularly subjected to examination, is certainly the duty of a botanist and agriculturist. That such an error as I pointed out in my last letter, and now wish again to combat, should have been persisted in so long, makes us mourn over the imperfection of our knowledge, since it might have appeared impossible that so strange a contradiction should have been insisted on, and by many of the first agriculturists, without their being struck with the strange inconsistency of the two facts which are both admitted as true, viz. that we can bury our vegetables with the certainty of their making in a few months good manure, fit to nourish plants; and that we can put our vegetables into the same earth for the winter months, to preserve them from decay and from the influence of the frost. Thus we place them in the same ground, for the same time, and in almost the same manner, both to destroy and to preserve them. It is certain that we cannot be successful in both cases; and as daily experience makes us assured of the latter fact, we should hence have been led to doubt the first. It is admitted that a few succulent leaves will decay under these circumstances, but this will not be the case even with the leaves of trees, and certainly with no species of woody matter. Nor is it a greater mistake or a more fatal one to agriculture, to dig up our weeds at a great expense, and then replace them in the earth. A clean soil is one of the first requisites for good farming; whereas we do all in our power, by burying weeds and green crops, to render the earth as foul as possible.

I have in my last letter shown that no vegetable can be of use as manure till it has passed through all the various steps which precede decomposition. It has always appeared to me that there was a strange confusion made by agriculturists in comparing fresh vegetables with manure; no two things can be more different, yet they reason as if the same operations took place in both; whereas the first effect to be produced on the recent plant is to kill it, a process of no small difficulty; while the vegetable matter in the manure is certainly dead. It has passed through the stomach of the animal, has been exposed there to a high temperature, and yet often without being entirely decomposed; since considerable quantities of straws and clover stalks will be found in dung not yet digested, though exposed not only to such heat, but to the dissolving power of the gastric juices. How then can we expect that the earth (so cold in comparison) will so soon decompose the vegetable matter, and what would be a still greater miracle, convert it into mould, when it has only that sap to assist in its decay, which certainly possesses no digestive or reducing powers? So far indeed are the vegetables when placed in the ground from making manure, that as soon as the part of the stem which is opposite a branch touches the earth, roots are directly nourished, and soon protruded; and let the process of decay proceed ever so far before they are buried, it is directly stopped, and the earth is sure to arrest its progress instead of accelerating the decomposition.

I have now dug up another trench, which has been preserved since last May,* and not opened till the 1st of the present month; it fully confirms all I before made known respecting the excessive duration of vegetable life, with many curious circumstances that greatly assist me in the acquirement of a more perfect knowledge of plants; while they confirm many of the most important points that I have before ascertained by means of dissections, and advanced on vegetable physiology.

All the weeds natural to the soil, and the herbaceous plants, were growing again, sickly, though firmly; many of them even piercing the earth, and appearing just shooting above, and throwing out fresh germs, except the conium maculatum, which I have always found to die in the leaves, though not in the root. I this time made a thorough trial of fresh aquatic plants; as they decay so immediately on being taken out of the water, I supposed they would die still quicker under ground, and would of course form an excellent manure. I, therefore, buried several plants of potamogeton and ranunculus aquatilis, which both appeared to decay as soon as taken from the water; the pit was opened four months after burying them, and they were perfectly alive, the first fermentation having stopped the moment they entered the earth; so that they appeared as fresh as when they had been taken out of the water only for a very few hours. This plainly shows that there is no trusting to any thing but experimental knowledge; for though a part of these plants had really begun to decay before they were placed in the earth, yet the fermentation was directly arrested;

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* May, 1817.

the most convincing proof that plants, even of the tenderest kind, and such as most quickly decompose in the air, will require a very long time to pass through this process in the earth.

Of the various branches of trees placed in the pit, a number of them having lost their leaves (at the proper time I suppose) were full of bud, and those buds were again ready to burst with their various contents, though the scales were not yet expanded; a strong confirmation, I think, that the whole process of the flowers and leaves is formed in the interior, and not in the bark, as Mr. Knight supposes. Had this been the case, would not some assistance have been wanted to bestow air, elaborate the juices, recompose them, and make amends for the light they must require in the bud? whereas in the interior all is ready prepared. The root is the complete laboratory of plants, whence the juices are propelled, and formed according to their respective affinity. But I have always found that every agricultural experiment only more thoroughly proves and confirms what dissection had before shown me. In the oak branches I could detect both the flower and leaf. The horse chesnut was ready to protrude its leaves, while the flowers were less backward than they generally are on the 1st of May. But what was most curious, the buds had none of the glutinous matter which generally surrounds them, and the scales were completely fixed, which leads me to believe that the flowers (if the branches had not been taken out of the earth at this time) would not have protruded, though the leaves would; but I shall certainly repeat this experiment next year. The walnut was quite dead, but the ash was apparently in the act of giving out its flowers. The alder had many leaf buds, but few flower buds: they all died soon after being exposed to the air; a fact which shows how fully unfit a medium the earth is for making vegetable manure.

The method which the Chinese employ for forming little diminutive fruit trees for the ornament of their trays, is analogous to this subject, and shows how easy it is to make the roots of plants grow in any part. They place a shelf close to the projecting branch of the tree which they mean thus to reduce; they surround it with earth, fixing a bottle of water above with a long piece of felt hanging out of it; the water then drops on the earth, constantly keeping it moist, and soon the roots are sure to shoot from the opposite side, forming radicles enough to nourish the branch, when it is separated from its parent plant; thus a whole tree is by degrees formed into many small ones. I have found this plan to succeed even with forest trees, as well as with every sort of fruit tree, one or two excepted. This very much resembles the manner in which the long roots form in the earth; they continually shoot from the part of the stem opposite to the branch, and in grass from the ends of the shoots; in other plants they not only form opposite roots as in trees, but the middle root throws out side roots and radicles to nourish any new shoot that may be formed.

For some time past I have been endeavouring to enforce the proposition that all plants are favourable to one particular soil, the tenacious manner in which weeds grow, the difficulty of killing them, the variety peculiar to each soil, the plants found in certain situations, and in these only, are strong proofs that soil is of the first consequence to the existence of a plant. Then there are many plants that can live only where a peculiar ingredient (either earth or salt) is found. Vegetables near the sea coast will not thrive unless the soil contains a certain quantity of muriate of soda. How often have seeds been found totally dormant in one kind of earth, and when removed into a different soil have been revived and forced into life? Duhamel gives many examples of this, and I have myself frequently experienced it. The parietaria and borage will not thrive except in such soils as contain nitrate of potash or nitrate of lime; saintfoin will not grow well without chalk. I have now tried, for three years past, many different corns (particularly wheat) in clay, gravel, chalk, sand, and a rich mould, to see in which each succeeds best, manuring all alike; and I have found that far from always choosing the richest soil, there are quite as many do well in the others; provided it was their original and proper soil, and congenial to their nature, they would give a much larger proportion than the same wheat would do in a richer soil without this advantage. I have known sand plants, which were constantly affected by a sort of dropsy, when put into a rich soil, completely cured, by being placed in their own original and proper earth. The red lammas wheat always produced the proportion of nine in sand to six in clay, when both were equally manured; and the Taunton wheat will give in a rich soil thirteen to four in a sand. The blue cone wheat gave ten in clay to only five in sand, and only seven in a rich soil. The Dantzic wheat gave in a sandy loam the proportions of eleven to seven in clay, and only six in chalk, all manured alike; and they maintained nearly the same proportion during the three years that the experiment was continued. I tried about ten varieties of wheats, and the numbers in that time varied very little in three successive trials. The fact is still more decided with respect to clovers, and many other plants, as lucern, saintfoin, hogs' peas, beans, canary seed, hops, briza media, poa pratensis, and trivialis, cynosurus cristatus, which are all decided chalk plants. In clay we have the hop-trefoils, cabbage of every kind, festuca calamaria, trifolium procumbens, poa pratensis, medicago sativa; while festuca fluitans, festuca elatior, and poa aquatica, grow still better in wet clay. In sandy soils the most decided plants are found, as the turnip, carrot, parsnip, beet, annual meadow grass, the cow grass, bird's-foot trefoil, avena flavescens. The cow grass is so entirely fed by the atmosphere, and is, therefore, so truly a sand plant, that it wants but little if any manure. Indeed the advantage of placing a plant in its own soil is, that it will do with half that quantity. When we are thoroughly persuaded and informed what plants really can take nutriment from the root and those which cannot, it will be a vast saving to the farmer; for in fact very few sand plants require manure. I should this summer have completed the business of my trenches, and the trial of all agricultural plants, in the five soils above mentioned, if a most severe illness had not impeded my progress for some time.

If a botanist is asked how are plants fed, he will probably answer, without hesitation, "by means of the radicles which draw from the earth the nutriment which is consigned to the root for that purpose;" but I wish to know how those plants are to be nourished which have visibly and positively no radicles, or extremely few? Now this is the case certainly with two very large collections of plants, the mountain plants and the sand plants. If these vegetables, therefore, are not fed by the radicles, they must be supported by the atmosphere: is it not then of the greatest consequence to know which plants these are? for if they are wholly or principally supported by the atmosphere, they cannot certainly require manure. I think these propositions follow of course, and cannot well be refuted: to compare the root of a plant which requires a rich soil with the root of a sand plant will at once show the difference.

The size of the root is of no consequence whatever; it is the small threads which absorb the nourishment, and which alone show the nature of the plant; the turnip, carrot, and parsnip, have hardly any of these. The plants of the barren rock have also no radicles, and the root serves merely to fasten them to the spot, and to form the corculum of the seed; and this is so decisive that in many annuals, among the sand and mountain plants, the root is almost dead before the flower appears.

I do not despair that the time will soon arrive when every farmer will know the plants that exactly suit his soil, that he will be able chemically to appropriate the manure to the soil, and will be incapable of burying weeds and of turning in young crops. I am, Gentlemen, your obliged humble servant,

AGNES IBBETSON.

ARTICLE III.

On the Fountainhall Chalybeate Spring. By T. L. Dick, Esq. F.R.S.E.

(To Dr. Thomson.)

SIR, *Fountainhall, Jan. 26, 1818.*

REFERRING you to my communications of April 13 and July 9, 1816, on the subject of the Fountainhall Chalybeate

Spring, published in your 43d and 47th numbers, I now avail myself of being on the spot to copy for your *Annals* the following continuation of my father's register of its alternations. The thermometer was regularly marked as formerly; but as the temperature of the atmosphere seems to have had no influence at all in producing the phenomena, it is unnecessary to encumber the columns with it.

I have not leisure at present to send you, as formerly, a table of averages; and if I had, a glance at the particular items of the register will convince you that little satisfaction could be had from such a view. It is evident from the great *general* increase of the discharge of water which took place in the month of February last, and which seems to have continued almost up to the end of the period embraced by the memoranda, that an actual increase of the body of water in the mine must have taken place in that month.

An attentive observation of the motions of the well has satisfied my father that it is much more rapidly affected by any atmospherical change than the mercurial column. It must, therefore, frequently happen, that when both are marked at the same moment, an apparently anomalous result will be afforded, owing to the mercury yielding more tardily to the change of density. A visible alteration as well in the increase as in the diminution of discharge has often been noticed to take place whilst the observer has been standing by the fountain.

Register of the alternating Appearances in the Fountainhall Chalybeate Spring, continued. N. B. No Measurements made on Sundays.[*]

1816.
June 22, M, R, 23½ pints. B, 29·74.—A, 31½ pints. B, 29·65. A great deal of thunder, lightning, and rain, with hail.
24, M, R, 23 pints. B, 29·58.—A, 19 pints. B, 29·63.
25, M, R, 23 pints. B, 29·65.—A, 27½ pints. B, 29·58.
26, M, R, 32 pints. B, 29·46.—A, 31¾ pints. B, 29·39.
27, M, R, 20 pints. B, 29·50.—A, 18 pints. B, 29·59.
28, M, R, 16 pints. B, 29·70.—A, 20 pints. B, 29·70.
29, M R, 22½ pints. B, 29·69.—A, 24½ pints. B, 29·64.
July 1 M, R, 23½ pints. B. 29·39.—A, 21¾ pints. B, 29·39.
2, M, R, 23½ pints. B, 29·37.—A, 23¾ pints. B, 29·37.
3, M, R, 22 pints. B, 29·37.—A, 21¼ pints. B, 29·39.
4, M, R, 22½ pints. B, 29·40.—A, 25 pints. B, 29·39.
5, M, R, 21 pints. B, 29·39.—A, 20¼ pints. B, 29·42.
6, M, R, 21½ pints. B, 29·42.—A, 22½ pints. B, 29·40.
8, M, R, 22½ pints. B, 29·32. A great fall of rain last night and this morning.—A, 22 pints. B, 29·32. Rain all day.
9, M, R, 22 pints. B, 29·35.—A, 23½ pints. B, 29·30.
10, M, R, 25 pints. B, 29·25.—A, 25½ pints. B, 29·21.

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[*] "The letter R, signifies that the well was running over; F, that it was full; In. means the inches down, unless when specified otherwise; M, is morning; and A, afternoon. It is also to be noticed that the degree of Fahrenheit's thermometer having been remarked, it is indicated by T; and afterwards the elevation of the barometer having been also attended to, its height is indicated by B."—(See Mr. Dick's former paper, *Annals*, viii. 6.)

July 11, M, R, 23 pints. B, 29·19. Distant thunder yesterday and the day before, and this morning a heavy fall of rain.—A, 20 pints. B, 22·22. Rain.

12, M, R, 19½ pints. B, 29·24.—A, 18¾ pints. B, 29·27.

13, M, R, 16 pints. B, 29·36.—A, 16 pints. B, 29·40.

15, M, R, 30½ pints. B, 29·20.—A, 22 pints. B, 29·24.

16, M, R, 17 pints. B, 29·29.—A, 19¼ pints. B, 29·29. Rain.

17, M, R, 34 pints. B, 29·28.—A, 24½ pints. B, 29·20. Thunder and rain.

18, M, R, 33 pints. B, 29·04. A great fall of rain last night.—A, 28 pints. B, 29·04. Wind high from S. E. with showers of rain.

19, M, R, 24 pints. B, 29·04.—A, 19¼ pints. B, 29·08. Slight showers.

20, M, R, 10½ pints. B, 29·20.—A, 9 pints. B, 29·28.

22, M, R, 19 pints. B, 29·20.—A, 14 pints. B, 29·23. A great fall of rain.

23, M, R, 14¼ pints. B, 29·25.—A, 21 pints. B, 29·25. Showers of rain.

24, M, R, 15½ pints. B, 29·25.—A, not measured.

25, M, R, 11½ pints. B, 29·30. Rain.—A, 12 pints. B, 29·36.

26, M, R, 12¾ pints. B, 29·40.—A, 12 pints. B, 29;45.

27, M, R, 15½ pints. B, 29·43.—A, 18 pints. B, 29·39. A very heavy fall of rain since two o'clock, p. m., which still continues.

29, M, R, 16½ pints. B, 29·34.—A, 17 pints. B, 29·30.

30, M, R, 22 pints. B, 29·22.—A, 22 pints. B, 29·19.

31, M, R, 19 pints. B, 29·19.—A, 18 pints. B, 29·19.

Aug. 1 M, R, 14¼ pints. B, 29·20.—A, 13 pints. B, 29·23.

2, M, R, 12 pints. B, 29·26.—A, 11¾ pints. B, 29·28.

3, M, R, 13 pints. B, 29·29.—A, 10¾ pints. B, 29·31.

5, M, R, 12 pints. B, 29·40.—A, 11 pints. B, 29·44.

6, M, R, 10¾ pints. B, 29·46.—A, 12½ pints. B, 29·46.

7, M, R, 16 pints. B, 29·32.—A, 20¼ pints. B, 29·29.

8, M, R, 19 pints. B, 29·24.—A, 17 pints. B, 29·24.

9, M, R, 15¾ pints. B, 29·23. Rain last night.—A, 10¼ pints. B, 29·28. Distant thunder, and a great deal of rain.

10, M, R, 3¼ pints. B, 29·40.—A, 11¾ pints. B, 29·38. Rain in the afternoon.

12, M, R, 6¾ pints. B, 29·40.—A, 5¾ pints. B, 29·49. A high westerly wind.

13, M, R, 7 pints. B, 29·50.—A, 9½ pints. B, 25·52.

14, M, R, 14 pints. B, 29·42.—A, 17¾ pints. B, 29·36. A great fall of rain, with an easterly wind, since morning.

15, M, R, 21¾ pints. B, 29·24. A great fall of rain last night, which still continues.—A, 19¼ pints. B, 29·22. Wind easterly, with a wetting rain all day.

16, M, R, 14 pints. B, 29·24.—A, 10 pints. B, 29·26. Wind N. W.; frequent showers since morning.

17, M, R, 7¾ pints. B, 29·32. A great deal of rain until a late hour last night.—A, 1 pint. B, 29·43.—Eight o'clock evening run only a few drops in the minute.

18, Stopped running. B, 29·66.

19, M, ⅛ inch down. B, 29·73.—A, R, 3¼ pints. B, 29·76. A little rain last night.

20, M, R, 4½ pints. B, 29·79.—A, 6 pints. B, 29·80.

21, M, R, 8¼ pints. B, 29·80.—A, 11¼ pints. B, 29·80. A little rain in the forenoon.

22, M, R, 12½ pints. B, 29·78. Rain last night.—A, 10 pints. B, 29·78.

23, M, R, 10¼ pints. B, 29·78.—A, 12 pints. B, 29·77. Some rain.

24, M, R, 7¾ pints. B, 29·79. Heavy showers of rain last evening, and a great deal during the night, and early this morning.—A, 7¾ pints. B, 29·82.

26, M, R, 10 pints. B, 29·83.—A, 11¼ pints. B, 29·80. A drizzling shower in the forenoon.

27, M, R, 6½ pints. B, 29·87. A thick fog.—A, 8¾ pints. B, 29·82. Hot sunshine.

28, M, R, 8¼ *pints.* B, 29·80. Frost rime on north windows.—A, 10½ *pints. B, 29·78.*

Aug. 29, M, R, 14½ pints. B, 29·64.—A, 14 pints. B, 29·60.
30, M, R, 12¾ pints. B, 29·56.—A, 19 pints. B, 29·42. A little rain.
31, M, R, 28 pints. B, 29·18. Rain all night, and still continues.—A, 13½ pints. B, 29·25.
Sept. 2, M, R, 5¼ pints. B, 29·31.—A, 6¼ pints. B, 29·34.
3, M, R, 11¼ pints. B, 29·31. Showers of rain.—A, 13 pints. B, 29·29. Frequent showers in the forenoon.
4, M, R, 19 pints. B, 29·20. A high westerly wind, with frequent heavy showers of rain.—A, 14½ pints. B, 29·20. Rain all day, and very heavy in the afternoon.
5, M, stopped running, and ¼ inch down. B, 29·30.—A, 1 in. B, 29·47. Sunshine.
6, M, 1 in. B, 29·55. A thick fog.—A, R, 8¾ pints. B, 29·43.
7, M, R, 9¾ pints. B, 29·33. Rain last night.—A, 10 pints. B, 29·33. Rain.
9, M, R, 6¼ pints. B, 29·27.—A, 26¼ pints. B, 29·02. Frequent wetting showers of rain.
10, M, R, 28 pints. B, 28·86. A high westerly wind.—A, 1¾ pints. B, 29·00. A furious gale of wind at west, which broke some large limbs from the trees.—Seven o'clock, p. m. stopped running, and ¼ inch below the brim. Storm abated.
11, M, 1½ inch down. B, 29·22.—A, ½ inch. B, 29·30. Frequent showers during the day.
12, M, 1¼ inch. B, 29·43. Rain last night.—A, 1½ in. B, 29·59.
13, M, ½ in. B, 29·69.—A, R, 7 pints. B, 29·53. A high westerly wind.
14, M, R, 12 pints. B, 29·38.—A, 1½ pint. B, 29·42. Rain in the morning.—Half-past six o'clock, p. m. falling in drops not measurable. B, 29·46.
16, M, ¾ in. down. B, 29·60. Calm.—A, ¾ in. B, 29·69. A warm, bright sunshine.
17, M, ¼ in. B, 29·70.—A, R, 2¾ pints. B, 29·66. Rain in the morning, and now heavy.
18, M, F. B, 29·66. A great fall of rain since last night.—A, ¼ in. B, 22·73. Sunshine, and not a breath of wind.
19, M, ¼ in. B, 29·77. Calm, and a heavy dew.—A, Falling in quick, successive drops. B, 29·77.
20, M, R, 2½ pints. B, 29·70.—A, 7¼ pints. B, 29·62.
21, M, R, 12 pints. B, 29·44.—A, 13¼ pints. B, 29·38.
23, M, 1 in. B, 29·58. Rain last night and this morning.—A, 1 in. B, 29·60.
24, M, R, 4½ pints. B, 29·47.—A, 2¾ pints. B, 29·48.
25, M, ¼ inch. B, 29·58.—A, 1¾ in. B, 29·62.
26, M, ½ in. B, 29·73.—A, F, B, 29·68. Rain.
27, M, 1 in. B, 29·74.—A, F, and dropping. B, 29·68.
28, M, R, 9 pints. B, 29·44.—A, 11½ pints. B, 29·38. A high west wind, and heavy showers.
30, M, R, 5½ pints. B, 29·08.—A, ¼ in. B, 29·18.
Oct. 1, M, R, 4½ pints. B, 29·13.—A, ⅛ inch. B, 29·13. A good deal of rain since morning.
2, M, ¼ in. B, 29·14.—A, 1 in. B, 29·20.
3, M, 3 in. B, 29·46.—A, 2¾ in. B, 29·46.
4, M, 1½ in. B, 29·46. Showers.—A, 1 in. B, 29·49. Showers.
5, M, 1 in. B, 29·40. A great fall of rain since last night.—A, 1¼ in. B, 29·42.
7, M, 3 in. B, 29·70. More rain last night.—A, 3 in. B, 29·79. A brisk breeze of wind.
8, M, 1½ in. B, 29·75.—A, 1¾ in. B, 29·75.—Slight showers since morning.
9, M, 1 in. B, 29·78. Showers last night.—A, 1 in. B, 29·78.
10, M, ½ in. B, 29·72.—A, R, in drops. B, 29·64. A fall of rain.
11, M, F. B, 29·60. Rain last night.—A, 1½ in. B, 29·66.
12, M, 1½ in. B, 29·70.—A, ¾ in. B, 29·70.
14, M, 1½ in. B, 29·59. Rain last night.—A, 2 in. B, 29·70.
15, M, 1¼ in. B, 29·65.—A, 1 in. B, 29·68.
16, M, 1 in. B, 29·65.—A, R, 1 pint. B, 29·50. Rain this afternoon.
17, M, R, 2¼ pints. B, 29·39. Rain last night.—A, 4½ pints. B, 29·25.

Oct. 18, M, ¼ in. B, 29·35.—A, 1¼ inch. B, 29·40.
19, M, F. B, 29·37.—A, R, 11¾ pints. B, 29·20. A high west wind all day.
21, M, 3 in. B, 29·35.—A, 1¾ in. B, 29·40.
22, M, F. B, 29·26.—A, 1 in. B, 29·26.
23, M, 3 in. B, 29·40.—A, 2 in. B, 29·39. Brisk wind.
24, M, ½ in. B, 29·28. Rain last night.—A, 1 in. B, 29·28.
25, M, F. B, 29·22.—A, R, 4½ pints. B, 29·15. Rain, and a high S.E. wind.
26, M, 3½ in. B, 29·21. Much rain last night, and a rime this morning.—A, 4½ in. B, 29·38.
28, M, 2 in. B, 29·52.—A, 1¼ in. B, 29·48.
29, M, F. B, 29·32. Rain last night.—A, R, 1 pint. B, 29·27.
30, M, F. B, 29·22.—A, F. B, 29·18.
31, M, ¼ in. B, 29·13. A great fall of rain since last night.—A, ¼ inch. B, 29·12. Rain.
Nov. 1, M, ½ in. B, 29·07. A great deal of rain since last night.—A, 1 in. B, 29·05.
2, M, ¾ in. B, 29·01. Rain last night.—A, 1¼ in. B, 29·01.
3. A great deal of rain, and high east wind.
4, M, 7 in. B, 29·51. Rain last night.—A, 7¼ in. B, 29·58. Wind, and showers of rain.
5, M, 4½ in. B, 29·61.—A, 3 in. B, 29·50.
6, M, R, in drops. B, 29·21. Rain.—A, R, 9¾ pints. B, 29·06. Showers of rain during the day.
7, M, R, 6¾ pints. B, 28·95.—A, ¼ in. B, 28·99.
8, M, 2¾ in. B, 29·09.—A, ½ in. B, 29·04.
9, M, R, 21 pints. B, 28·80.—A, 8 pints. B, 28·74. Snow, rain, and sleet, with a stormy wind.
11, M, 5¾ in. B, 29·15.—A, R, 12 pints. B, 28·82. Snow, sleet, and rain.
12, M, 4 in. B, 28·93.—A, 6¼ in. B, 29·18.
13, M, 4 in. B, 29·06. A high west wind last night and this morning.—A, 4 in. B, 29·10. A brisk west wind.
14, M, 2 in. B, 29·03. Fall of snow.—A, 3 in. B, 29·03. Frequent showers of snow.
15, M, 3¼ in. B, 29·08. Snow, with a high north wind.—A, 5¾ in. B, 29·30. A clear sunshine since morning.
16, M, 7¾ in. B, 29·58.—A, 8¼ in. B, 29·68.
17, Showers of snow and sleet, with high S.W. wind.
18, M, ¼ in. B, 29·22.—A, ⅔ in. B, 29·15.
19, M, 2½ in. B, 29·18.—A, 1½ in. B, 29·18.
20, M, 2¼ in. B, 29·27.—A, 4 in. B, 29·32.
21, M, 5¼ in. B, 29·50.—A, 4¾ in. B, 29·49.
22, M, 3½ in. B, 29·49.—A, 3¾ in. B, 29·53.
23, M, 3 in. B, 29·56.—A, 2 in. B, 29·54.
25, M, ¾ in. B, 29·30.—A, 2 in. B, 29·32.
26, M, 4¼ in. B, 29·44.—A, 5 in. B, 29·50.
27, M, 3¼ in. B, 29·48.—A, 6 in. B, 29·58.
28, M, 5½ in. B. 29·73.—A, 4 in. B, 29·68.
29, M, 6¾ in. B, 30·00.—A, 7½ in. B, 30·07. Wind west, brisk, and ground getting very dry.
30, M, 8½ in. B, 30·28. At 12 o'clock noon, B, 30·32.—A, 8 in. B, 30·30.
Dec. 2, M, 2 in. B, 29·96.—A, 2¾ in. B, 29·96.
3, M, 4¼ in. B, 29·98.—A, 3¼ in. B, 30·00.
4, M, 3¼ in. B, 29·96.—A, 2½ in. B, 29·87.
5, M, ¼ in. B, 29·53.—A, R, 4½ pints. B, 29·22. High S. W. wind all day.
6, M, R, 14¼ pints. B, 28·90. A great deal of rain last night.—A, 2½ pints. B, 28·98.
7, M, 1½ inch. B, 28·98.—A, 3 in. B, 29·02.
9, M, 4 in. A, 29·10.—A, 2 in. B, 29·06.
10, M, 4 in. B, 29·11.—A, ¼ in. B, 28·92. High wind.
11, M, F. B, 28·82. Snow on the ground.—A, 2¼ in. B, 28·82.

Dec. 12, M, 5 in. B, 28·90. Snow last night.—A, 3 in. B, 28·88.
13, M, 3 in. B, 28·84. A little more snow last night.—A, 3¼ in. B, 28·84.
14, M, 4½ in. B, 28·85. More snow.—A, 5 in. B, 28·91.
16, M, 6¼ in. B, 28·90.—A, 7 in. B, 29·00.
17, M, 5 in. B, 29·00. A heavy fall of snow.—A, 2 in. B, 28·88. Snow and sleet all day.
18, M, 5 in. B, 29·03. Rain and sleet.—A, 10 in. B, 29·43.
19, M, Well dry. B, 29·96.—A, Well dry. B, 30·08.
20, M, 10 in. B, 30·14.—A, 8 in. B, 30·09.
21, M, 4 in. B, 25·84. Flashes of lightning seen early this morning before day break; they were very close to the surface of the ground.—A, 2 in. B, 29·66.
23, M, F, and dropping. B, 29·17.—A, F. B, 29·18.
24, M, R, equal to a goose quil. B, 28·98.—A, F. B, 28·95.
25, M, 4 in. B, 28·11.—A, 3¼ in. B, 29·08.
26, M, R, equal to a large goose quill. B, 28·80.—A, R, 1 pint. B, 28·78.
27, M, 3 in. B, 28·82.—A, 3 in. B, 28·82.
28, M, 6 in. B, 29·08.—A, 1½ in. B, 28·84. A great fall of snow, sleet, and rain.
30, M, 13 in. B, 29·56.—A, 7 in. B, 29·60.
31, M, 3¼ in. B, 29·49.—A, 1 in. B, 29·24.
1817.
Jan. 1, M, F. B, 28·98.—A, R, 6½ pints. B, 28·59. A high S. W. wind, with frequent showers of rain and hail.
2, M, R, 1½ pint. B, 28·87.—A, ¼ in. B, 28·90.
3, M, 2½ in. B, 28·96.—A, 2½ in. B, 28·99.
4, M, R, 4 pints. B, 28·84. A wetting rain.—A, 6¼ pints. B, 28·82.
6, M, 2 in. B, 28·98. Snow on the ground.—A, 6 in. B, 29·27.
7, M, 12½ in. B, 29·85.—A, 11 in. B, 29·97.
8, M, 7½ in. B, 29·94.—A, 5 in. B, 29·89.
9, M, 7½ in. B, 29·94.—A, 3½ in. B, 29·94.
10, M, 2½ in. B, 29·88.—A, 1½ in. B, 29·84.
11, M, 2 in. B, 29·90.—A, 1½ in. B, 29·83.
13, M, R, 8½ pints. B, 29·24.—A, 15½ pints. B, 29·02.
14, M, R, the size of a goose quill. B, 29·08.—A, R, weaker. B, 29·15.
15, M, R, 11½ pints. B, 28·93.—A, 9½ pints. B, 28·90.
16, M, R, like a small quill. B, 28·95.—A, 17¼ pints. B, 28·84. A fall of snow.
17, M, R, 15 pints. B, 28·73.—A, 12½ pints. B, 28·72.
18, M, R, 5 pints. B, 28·74.—A, R, in drops. B, 28·72.
20, M, R, 10 pints. B, 28·67.—A. 12¼ pints. B, 28·72. A good deal of rain.
21, M, 4¼ inch. B, 28·76. A storm of wind last night, and a little snow this morning.—A, 6 in. B, 28·96. Frequent heavy showers of snow during the day, with a high N. W. wind.
22, M, R, in drops. B, 28·84. Rain, with a high west wind.—A, 3 in. B, 28·98. Wind and rain.
23, M, 3 in. B, 29·04. Heavy rain.—A, R, very small. B, 29·01. Rain and wind.
24, M, 8¼ in. B, 29·64. A calm.—A, 5½ in. B, 29·59. A return of wind and rain.
25, M, 3¼ in. B, 29·56.—A, 1¼ in. B, 29·55.
27, M, 4½ in. B, 29·84.—A, 4 in. B, 29·99.
28, M, 2 in. B, 29·96.—A, R, 1½ pint. B, 29·82.
29, M, R, very small. B, 29·76.—A, R, still less. B, 29·82.
30, M, R, 1¼ pints. B, 29·84.—A, 1¼ pints. B, 29·89.
31, M, F. B, 30·00.—A, F, and dropping. B, 30·04.
Feb. 1, M, F. B, 30·12.—A, R, size of a quill. B, 30·12.
3, M, R, 8½ pints. B, 29·84. A fire-ball seen this morning before daylight, flying from south to north, with a long tail, and emitting sparks of fire.—A, 13 pints. B, 29·70.
4, M, R, 22 pints. B, 29·20.—A, 34 pints. B, 29·10.
5, M, R, 28½ pints. B, 29·10. Snow last night.—A, 17½ pints. B, 29·29.
6, M, R, 15 pints. B, 29·29.—A, 19½ pints. B, 29·21. Very high W. wind.

Feb. 7, M, R, 8 pints. B, 29·42. Last night it blew a hurricane from the N. W.—A, 8 pints. B, 29·44.
8, M, R, 13¼ pints. B, 29·44. Wind W.; very high.—A, 19 pints. B, 29·37. Violent storm of wind and rain.
10, M, R, 15. B, 29·48.—A, 12½ pints. B, 29·54.
11, M, R, 10¼ pints. B, 29·64.—A, 14½ pints. B, 29·52.
12, M, R, 37 pints.—B, 29·00.—A, 20 pints. B, 29·27.
13, M, R, 20 pints. B, 29·30.—A 28 pints. B, 29·10. A fall of sleet, and then rain.
14, M, R, 29¼ pints. B, 29·04. A fall of sleet, with a high west wind.—A, 21½ pints. B, 29·07.
15, M, R, 28½ pints. B, 29·04.—A, 30 pints. B, 28·92. A violent storm of wind from N. W. and four peals of thunder heard, and lightning seen.
17, M, R, 18½ pints. B, 29·22.—A, 22¼ pints. B, 29·18. A high wind, and heavy showers of rain.
18, M, R, 18½ pints. B, 29·38. Thunder and lightning last night.—A, 20½ pints. B, 29·20.
19, M, R, 5¼ pints. B, 29·60.—A, 9¾ pints. B, 29·63.
20, M, R, 35 pints. B, 29·07. A storm of wind last night, with rain.—A, 38 pints. B, 28·96. A fall of rain.
21, M, R, 34 pints. B, 28·92. Snow on the ground.—A, 25½ pints. B, 28·92.
22, M, R, 19 pints. B, 29·24.—A, 5½ pints. B, 29·86.
23, Storm of wind and rain.
24, M, R, 22 pints. B, 29·24.—A, 19½ pints. B, 29·30.
25, M, R, 23½ pints. B, 29·19—A, 27¼ pints. B, 29·20.
26, M, R, 31 pints. B, 29·11. Snow.—A, 29 pints. B, 29·11.
27, M, R, 35 pints. B, 28·96. A tempest of wind N. W., with rain.—A, 29¼ pints. B, 20·14. Wind continues.
28, M, R, 27 pints. B, 29·20.—A, 27 pints. B, 29·19.
March 1, M, R, 30 pints. B, 29·05. Calm, but rain last night.—A, 33½ pints. B, 29·00. A heavy rain.
2, A little snow.
3, M, R, 37 pints. B, 28·80. A storm of wind last night.—A, 40 pints. B, 28·04.
4, M. R, 35 pints. B, 28·72. A fall of rain last night, and thin snow.—A, 33½ pints. B, 28·76. Much sleet.
5, M, R, 27 pints. B, 28·80 A little snow.—A, 22½ pints. B, 28·87. Showers of sleet since morning.
6, M, R, 37 pints. B, 28·78.—A, 32¼ pints. B. 28·79.
7, M, R, 28 pints. B, 28·84.—A, 22¼ pints. B, 28·90.
8, M, R, 24½ pints. B, 28·85. Snow on the ground.—A, 25½ pints. B, 28·85.
10, M, R, 12¼ pints. B, 29·49.—A, 7¼ pints. B, 29·63.
11, M, R, 23 pints. B, 29·50.—A, 29¾ pints.—B, 29·46.
12, M, R, 35 pints. B, 29·38.—A, 36 pints. B, 29·37.
13, M, R, 32 pints. B, 29·33.—A, 29 pints. B, 29·57.
14, M, R, 18¼ pints. B, 29·80.—A, 16¾ pints. B, 29·84.
15, M, R, 32 pints. B, 29·74.—A, 29 pints. B, 29·76.
17, M, R, 26 pints. B, 29·20. Rain.—A, 26 pints. B, 29·90.
18, M, R, 37 pints. B, 29·67.—A, 41½ pints. B, 29·40. A high west wind.
19, M, R, 42½ pints. B, 29·32.—A, 43 pints. B, 29·32. Severe blasts of snow and hail during the day.
20, M, R, 36 pints. B, 29·48.—A, 29 pints. B, 29·63. Wind high.
21, M, R, 31 pints. B, 29·69. Calm.—A, 34½ pints. B, 29·59.
22, M, R, 42¼ pints. B, 29·50.—A, 34 pints. B, 29·52.
24, M, R, 41 pints. B, 29·34.—A, 42¼ pints. B, 29·28.
25, M, R, 36 pints. B, 29·33.—A, 29¾ pints. B, 29·42.
26, M, R, 36¼ pints. B, 29·20.—A, 39¾ pints. B, 22·24. A very high west wind.
27, M, R, 30 pints. B, 29·60. Calm.—A, 28 pints. B, 29·70.
28, M, R, 36¾ pints. B, 29·35. Rain.—A, 43 pints. B, 29·33.

March 29, M, R, 43 pints. B, 29·16.—A, 36 pints. B, 29·28.
31, M, R, 28½ pints. B, 29·76.—A, 23 pints. B, 29·92.
April 1, M, R, 31 pints. B, 29·89.—A, 29 pints. B, 29·89.
2, M, R, 29½ pints. B, 29·90.—A, 26½ pints. B, 30·02.
3, M, R, 25¼ pints. B, 30·10.—A, 30 pints. B, 30·16. At 12 o'clock the B was at 30·20.
4, M, R, 36 pints. B, 30·10.—A, 35 pints. B, 30·4.
5, M, R, 40 pints B, 29·98.—A, 35 pints. B, 30·00.
7, M, R, 39½ pints. B, 30·17.—A, 43 pints. B, 30·04.
8, M, R, 40 pints. B, 29·70.—A, 45 pints. B, 29·50. High wind.
9, M, R, 38½ pints. B, 29·62.—A, 44 pints. B, 29·64.
10, M, R, 42 pints. B, 29·68. Snow.—A, 35¼ pints. B, 29·83.
11 M, R, 35¾ pints. B, 29·90.—A, 44 pints.—B, 29·79.
12, M, R, 44 pints. B, 29·69.—A, 45 pints. B, 29·64.
14, M, R, 39 pints. B, 29·70.—A, 40 pints. B, 29·64.
15, M, R, 42 pints. B, 29·55.—A, 42 pints. B, 29·50
16, M, R, 40 pints. B, 29·46.—A, 32 pints. B, 29·70.
17 M, R, 29 pints. B, 29·89.—A, 31 pints. B, 29·94.
18, M, R. 3 pints. B, 29·94.—A, 32½ pints. B, 29·96
19, M, R, 33 pints. B, 30·00.—A, 33 pints. B, 30·05.
21, M, R, 37 pints. B, 30·09.—A, 39 pints. B, 30·05.
22, M, R, 37 pints. B, 30·04.—A, 38½ pints. B, 30·00.
23, M, R, 4 pints. B, 29·98.—A, 4¼ pints. B, 29·98.
24, M, R, 38 pints. B, 30·00.—A, 40 pints. B, 30·05.
25, M, R, 40 pints. B, 30·02.—A, 42½ pints. B, 29·98.
26, M, R, 44 pints. B, 29·84.—A, 48 pints. B, 29·70.
28, M, R, 38 pints. B, 29·74.—A, 46 pints. B, 29·70.
29, M, R, 46 pints. B, 29·47.—A, 48 pints. B, 29·38. Frequent showers of sleet and rain.
30, M, R, 41 pints. B, 29·50.—A, 37 pints. B, 29·63.
May 1, M, R, 35 pints. B, 29·70.—A, 35 pints. B, 29·73.
2, M, R, 37 pints. B, 29·68.—A, 39 pints. B, 29·62.
3, M, R, 44 pints. B, 29·47.—A, 44 pints. B, 29·37. Rain.
5, M, R, 38 pints. B, 29·43.—A, 37 pints. B, 29·39.
6, M, R, 34 pints. B, 29·58.—A, 32 pints. B, 29·77.
7, M, R, 31¾ pints. B, 29·88.—A, 37 pints. B, 29·70.
8, M, R, 37 pints. B, 29·60.—A, 38½ pints. B, 29·65.
9, M, R. 38 pints. B, 29·60.—A, 43 pints. B, 29·42.
10, M, R, 45 pints. B, 29·20.—A, 46¼. B, 29·18. Rain.
12, M, R, not measured.—A, 41 pints. B, 29·03. Rain.
13, M. R, 32 pints. B, 29·14.—A, 30½ pints. B, 29·20.
14, M, R, 30½ pints. B, 29·30.—A, 32 pints. B, 29·33. Thunder and rain.
15, M, R, 33 pints. B, 29·40.—A, 30 pints. B, 29·49.
16, M, R, 29 pints. B, 29·53.—A, 35 pints. B, 29·46.
17. M, R, 29 pints. B, 29·33.—A, 36½ pints. B, 29·33.
19, M, R, 19 pints. B, 29·11.—A, 36¼ pints. B, 29·28.
20, M, R, 32 pints. B, 29·30.—A, 31¼ pints. B, 29·36.
21, M, R, 32½ pinst. B, 29·39.—A, 33 pints. B, 29·36.
22, M, R, 36 pints. B, 29·24. Rain.—A, 40 pints. B, 29·20. Rain.
23, M, R, 36 pints. B, 29·20.—A, 36 pints. B, 29·20.
24, M, R, 36 pints. B. 29·17.—A, 35 pints. B, 29·17.
26, M, R, 33½ pints. B, 29·20.—A, 35 pints. B, 29·20. Rain.
27, M, R, 33¼ pints. B, 29·23.—A, 32 pints. B, 29·30. Much rain.
28, M, R, 29 pints. B, 29·44. Rain all night, and still continues.—A, 27¼ pints. B, 29·53.
29, M, R, 28 pints. B, 29·56.—A, 27½ pints. B, 29·60.
30, M, R, 27 pints. B, 29·63.—A, 27 pints. B, 29·64.
31, M, R, 30 pints. B, 29·61.—A, 36 pints. B, 29·53.
June 2, M, R, 40½ pints. B, 29·35.—A, 41 pints. B, 29·29.
3, M, R, 28 pints. B, 29·18. Rain last night.—A, 34 pints. B, 29·18.
4, M, R, 46 pints. B, 28·98. Rain last night.—A, 46 pints. B, 29·06. A storm of wind from west.
5, M, R, 32 pints. B, 29·32. Storm continued.—A, 33¼ pints. B, 29·44.

June 6, M, R, 33¼ pints. B, 29·43.—A, 31 pints. B, 29·50.
7, M, R, 36 pints. B, 29·37.—A, 43 pints. B, 29·37.
9, M, R, 38 pints. B, 29·32.—A, 32 pints. B, 29·37. Heavy showers.
10, M, R, 37 pints. B, 29·37. A thick fog.—A, 32¼ pints. B, 29·48. Much thunder and rain.
11, M, R, 32 pints. B, 29·59.—A, 32 pints. B, 29·58.
12, M, R, 36¼ pints. B, 29·30.—A, 41 pints. B, 29·25.
13, M, R, 41 pints. B, 29·25.—A, 43 pints. B, 29·14. Rain.
14, M, R, 48 pints. B, 28·98.—Wind E. a thick fog, and heavy rain.—A, 42 pints. B, 29·15. A great fall of rain.
16, M, R, 31 pints. B, 29·87.—A, 33 pints. B, 29·80.
17, M, R, 41½ pints. B, 29·62.—A, 37 pints. B, 29·60.
18, M, R, 46¼ pints. B, 29·53. A thick fog.—A, 46 pints. B, 29·46.
19, M, R, 48 pints. B, 29·40. A thick fog.—A, 47¾ pints. B, 29·40. Much thunder, and a little rain.
20, M, R, 45¼ pints. B, 29·50. A thick fog.—A, 43¼ pints. B, 29·53.
21, M, R, 37 pints. B, 29·61. A thick fog.—A, 35½ pints. B, 29·69. Bright sunshine.
22, A bright day, with distant peals of thunder.
23, M, R, 40 pints. B, 29·78. A fog.—A, 43 pints. B, 29·77. Sunshine.
24, M, R, 45¼ pints. B, 29·67. A fog.—A, 47 pints. B, 29·60. Thunder.
25, M, R, 46½ pints. B, 29·59.—A, 47 pints. B, 29·68.
26, M, R, 47 pints. B, 29·57.—A, 48 pints. B, 29·50.
27, M, R, 48 pints. B, 29·40.—A, 48 pints. B, 29·37.
28, M, R, 48 pints. B, 29·27. Rain.—A, 48 pints. B, 29·27.
30, M, R, 45 pints. B, 29·26. Rain.—A, 45 pints. B, 29·30.
July 1, M, R, 45 pints. B, 29·35. Rain last night.—A, 48 pints. B, 29·28.
2, M, R, 48 pints. B, 29·09. Much rain.—A, 47½ pints. B, 29·18. Showers of rain.
3, M, R, 37¼ pints. B, 29·31.—A, 37 pints. B, 29·39.
4, M, R, 37¼ pints. B, 29·39. A fog.—A, 39 pints. B, 29·36.
5, M, R, 40 pints. B, 29·26. A fog.—A, 42 pints. B, 29·26. Thunder heard.
7, M, R, 41 pints. B, 29·22. Rain last night.—A, 43 pints. B, 29·23.
8, M, R, 40 pints. B, 29·29.—A, 37 pints. B, 29·35.
9, M, R, 35¼ pints. B, 29·42.—A, 35 pints. B, 29·48.
10, M, R, 37½ pints. B, 29·48.—A, 37½ pints. B, 29·48. Rain.
11, M, R, 37½ pints. B, 29·48.—A, 39½ pints. B, 29·50.
12, M, R, 37¼ pints. B, 29·56.—A, 39 pints. B, 29·56. Showers.
14, M, R, 48 pints. B, 29·29. Much rain.—A, 48 pints. B, 29·25.
15 M, R, 48 pints. B, 29·13.—A, 41 pints. B, 29·20.
16, M, B, 36 pints. B, 29·30.—A, 33 pints. B, 29·39. Rain.
17 M, R, 31 pints. B, 29·40.—A, 31 pints. B, 29·40.
18, M, R, 31 pints. B, 29·44.—A, 32 pints. B, 29·50. Rain.
19, M, R, 32½ pints. B, 29·54.—A, 32½ pints. B, 29·54.
21, M, R, 29 pints. B, 29·36. Rain last night.—A, 47 pints. B, 29·21. Heavy showers.
22, M, R, 47 pints. B, 29·20.—A, 40 pints. B, 29·27. Rain.
23, M, R, 31½ pints. B, 29·50.—A, 28 pints. B, 29·64.
24, M, R, 28 pints. B, 29·64.—A, 34 pints. B, 29·60.
25, M, R, 36½ pints. B, 29·45. Rain.—A, 38 pints. B, 29·45. Rain.
26, M, R, 38 pints. B, 29·29. High west wind.—A, 39 pints. B, 29·20. Heavy showers.
28, M, R, 33 pints. B, 29·19.—A, 32 pints. B, 29·26. High west wind.
29, M, R, 35½ pints. B, 29·39.—A, 31 pints. B, 29·43. Rain.
30, M, R, 35½ pints. B, 29·35.—A, 36 pints. B, 29·30. Heavy showers.
31, M, R, 36 pints. B, 29·26.—A, 37½ pints. B, 29·26. Rain.
Aug. 1, M, R, 36 pints. B, 29·30. Heavy rain.—A, 30 pints. B, 29·40. Thunder and showers of rain.
2, M, R, 28½ pints. B, 29·49.—A, 32 pints. B, 29·51.
4, M, R, 40¼ pints. B, 29·17. Rain.—A, 34 pints. B, 29·32. A great fall of rain.
5, M, R, 29 pints. B, 29·58.—A, 25 pints. B, 29·63.
6, M, R, 27¼ pints. B, 29·60.—A, 31½ pints. B, 29·56.

Aug. 7, M, R, 34 pints. B, 29·44.—A, 35 pints. B, 29·40.
8, M, R, 37¼ pints. B, 29·24.—A, 39 pints. B, 29·18. Rain.
9, M, R, 39 pints. B, 29·13.—A, 34¼ pints. B, 29·18. A high N. W. wind, with rain.
11, M, R, 28¼ pints. B, 29·39. Rain.—A, 31¼ pints. B, 29·23.
12, M, R, 40 pints. B, 29·09. Rain.—A, 40 pints. B, 29·06.
13, M, R, 40 pints. B, 29·00.—A, 40 pints. B, 29·00. Rain.
14, M, R, 29½ pints. B, 29·10.—A, 32 pints. B, 29·09. Rain.
15, M, R, 34¼ pints. B, 29·05. Rain.—A, 30 pints. B, 29·12. High west wind, with showers of rain.
16, M, R, 25 pints. B, 29·20.—A, 25 pints. B, 29·24. Rain.
18, M, R, 21 pints. B, 29·34.—A, 25 pints. B, 29·34.
19, M, R, 31 pints. B, 29·20.—A, 30 pints. B, 29·22.
20, M, R, 30 pints. B, 29·22.—A, 30 pints. B, 29·32. High east wind, and heavy rain.
21, M, R, 17 pints. B, 29·55.—A, 16 pints. B, 29·65.
22, M, R, 16 pints. B, 29·70.—A, 20 pints. B, 29·72.
23, M, R, 27 pints. B, 29·69.—A, 32 pints. B, 29·64.
25, M, R, 41 pints. B, 29·96. A heavy rain.—A, 45 pints: B, 29·10. High east wind, with rain.
26, M, R, 45 pints. B, 28·93.—A, 43 pints. B, 28·95. Rain.
27, M, R, 29 pints. B, 29·97. Thunder last evening.—A, 23¼ pints. B, 29·12.—High E. wind, and heavy rain.
28, M, R, 16 pints. B, 29·29. Rain all night, and still continues.—A, 18 pints. B, 29·35.
29, M, R, 19 pints. B, 29·30. Rain last night. A, 19 pints. B, 29·38. Rain.
30, M, R, 16 pints. B, 29·50.—A, 22 pints. B, 29·48.
Sept. 1, M, R, 20¼ pints. B, 29·42.—A, 15 pints. B, 29·60.
2, M, R, 16 pints. B, 29·69.—A, 22 pints. B, 29·70.
3, M, R, 30½ pints. B, 29·52.—A, 34 pints. B, 29·45. A high south wind.
4, M, R, 25 pints. B, 29·58. Heavy rain last evening.—A, 23¼ pints. B, 29·67. Showers of rain.
5, M, R, 20¾ pints. B, 29·80.—A, 22¾. B, 29·80.
6, M, R, 32 pints. B, 29·61.—A, 27 pints. B, 29·68. Rain.
8, M, R, 27 pints. B, 29·67. A thick fog.—A, 27 pints. B, 29·11.
9, M, R, 22½ pints. B, 29·74.—A, 19¼ pints. B, 29·83.
10, M, R, 22 pints. B, 29·73.—A, 29½ pints. B, 29·59.
11, M, R, 25¾ pints. B, 29·59.—A, 30½ pints. B, 29·56.
12, M, R, 29 pints. B, 29·54.—A, 34 pints. B, 29·42.
13, M, R, 22 pints. B, 29·60.—A, 18¼ pints. B, 29·70.
15, M, R, 18 pints. B, 29·80.—A, 24¾ pints. B, 29·77.
16, M, R, 24¾ pints. B, 29·70.—A, 24¾ pints. B, 29·70.
17, M, R, 23¼ pints. B, 29·69.—A, 24½ pints. B, 29·70.
18, M, R, 24½ pints. B, 29·70.—A, 31 pints. B, 29·61.
19, M. R, 33¾ pints. B, 29·56. Rain.—A, 26 pints. B, 29·58.
20, M, R, 23 pints. B, 29·66.—A, 20 pints. B, 29·73.
22, M, R, 25 pints. B, 29·66.—A, 26½ pints. B, 29·66.
23, M, R, 23 pints. B, 29·66.—A, 23 pints. B, 29·69.
24, M, R, 27 pints. B, 29·61.—A, 28¼ pints. B, 29·49.
25, M, R, 36 pints. B, 29·20. Rain last night.—A, 41 pints. B, 28·99. High west wind.
26, M, R, 43¼ pints. B, 28·84.—A, 46¼ pints. B, 28·80. High west wind.
27, M, R, 39¼ pints. B, 28·80. Rain last night; high west wind.—A, 27 pints. B, 28·84. High west wind.
29, M, F, B, 29·38.—A, ½ in. B, 29·54.
30, M, F, B, 29·65.—A, R, 2 pints. B, 29·70.
Oct. 1, M, R, 25½ pints. B, 29·39.—A, 20½ pints. B, 29·45. Showers of rain, with a mixture of hail.
2, M, R, 14 pints. B, 29·59.—A, not measured.
3, M, R, 15 pints. B, 29·66.—A, 10 pints. B, 29·87.
4, M, R, 6 pints. B, 29·96.—A, 11 pints. B, 30·03.
6, M, R, 20 pints. B, 30·03.—A, 17¼ pints. B, 30·03.

Oct. 7, M, R, 19¼ pints. B, 30·00.—A, 20 pints. B, 29·94.
8, M, R, 20 pints. B, 29·89.—A, 20 pints. B, 29·86.
9, M, R, 18 pints. B, 29·81.—A, 18 pints. B, 29·75.
10, M, R, 19¼ pints. B, 29·70.—A, 19¼ pints. B, 29·70. Rain and east wind.
11, M, R, 14½ pints. B, 29·77.—A, 14½ pints. B, 29·80.
13, M, R, 12 pints. B, 29·96.—A, 13¼ pints. B, 29·98.
14, M, R, 15 pints. B, 29·97.—A, 15 pints. B, 29·94.
15, M, R, 19½ pints. B, 29·84. Some rain.—A, 15 pints. B, 29·80. Frequent drizzling showers.
16, M, R, 13½ pints. B, 29·83.—A, 13¼ pints. B, 29·86. A good deal of rain and some hail since last night.
17, M, R, 11 pints. B, 29·91.—A, 11 pints. B, 29·91.
18, M, R, 16½ pints. B, 29·84. Rain.—A, 19 pints. B, 29·80. Frequent and heavy showers of rain.
20, M, R, 19 pints. B, 29·79.—A, 15½ pints. B, 29·78.
21, M, R, 18½ pints. B, 29·65.—A, 20 pints. B, 29·50.
22, M, R, 6½ pints. B, 29·47.—A, 13 pints. B, 29·58.
23, M, R, 6 pints. B, 29·72.—A, 9 pints. B, 29·78.
24, M, R, 11¾ pints. B, 29·72.—A, 14 pints. B, 29·67.
25, M, R, 17 pints. B, 29·49.—A, 21¼ pints. B, 29·38. Brisk S. W. wind.
27, M, R, 20 pints. B, 29·18.—A, 30 pints. B, 28·98. A high S. W. wind, with heavy showers of rain.
28, M, R, 23 pints. B, 29·00.—A, 21 pints. B, 29·01. Showers of rain and sleet.
29, M, R, 17 pints. B, 29·01.—A, 14¼ pints. B, 29·05.
30, M, R, 32 pints. B, 28·80. A high west wind, and heavy showers at intervals.—A, 32 pints. B, 28·80. Flashes of lightning seen last night. Storm of wind still unabated.
31, M, R, 14 pints. B, 28·90. A great fall of rain last night, and storm of wind abated.—A, 4 pints. B, 29·00. A severe blast of hail, snow, and sleet, with a furious N. W. wind.

Enough of evidence appears in the foregoing register fully to corroborate the idea that the differences in the atmospherical pressure produce the *minor* and *more delicate changes* upon the basin of the well. Innumerable proofs of this will be noticed; and the averages of the two extremes are remarkably convincing when opposed to one another.

The highest extreme is 48 pints. B, 29·39 in. The lowest extreme is 13 in. down. B, 29·86 in.; making a difference between the two of no less than $\frac{47}{100}$ of an inch in the state of the mercurial column. But it is evident that the continued increase or diminution of the quantity of water upon what may be termed the great or ruder scale, is to be ascribed to some of those causes which have been enumerated in my former notices on this subject.

As the register of the alternations of the spring, contrasted with the barometer, has been now kept for 19 months, it becomes unnecessary to continue it longer; I shall not, therefore, trouble you again with it, but am, Sir, your obedient servant,

THOMAS LAUDER DICK,

ARTICLE IV.

On the Salt usually called Triple Prussiate of Potash. By Thomas Thomson, M.D. F.R.S. Regius Professor of Chemistry in the University of Glasgow.

MY attention was accidentally drawn to this salt in consequence of a visit, which I paid last winter to a *prussian blue* manufactory belonging to my friend Charles Macintosh, Esq. of Glasgow. This work is conducted in a manner that does great credit to the well known genius and skill of the proprietor. I was surprised to find in it the direct preparation of the triple prussiate of potash on a large scale in most magnificent crystals of the greatest purity and beauty. I was induced to make a few trials on this salt, thus furnished in such abundance, chiefly with the view of determining the component parts of the acid which it contains. Mr. Porrett was the first who demonstrated that this acid is of a peculiar nature; and from the constituents which he detected in it, he gave it the name of *ferrureted chyazic acid.* I was induced from strong analogies to consider this acid as a compound of an atom of cyanogen and an atom of iron; but it will be seen from the experiments which I have to state, that Mr. Porrett's opinion, that hydrogen exists in it as a constituent, is correct. Mr. Porrett's very ingenious and important experiments and conclusions respecting this acid will be found in the Phil. Trans. for the years 1814 and 1815.

1. The triple prussiate of potash when prepared in small quantities usually crystallizes in cubes, or at least in a form which to the eye appears cubic. But the large crystals formed in Mr. Macintosh's manufactory are always square plates with bevelled edges, usually about half an inch thick, and two or three inches in diameter. If we suppose an elongated octohedron, like the primitive form of the *anatase*; and suppose further, that the apex of each of the two four-sided pyramids of which the octohedron is composed, is truncated very deep by a plane parallel to the base of the pyramids, we shall have a pretty accurate idea of the appearance of these crystals. The two faces of the truncated pyramids, or the bevelled edges of the tables, are inclined to each other at an angle of about 135°, I have examined several hundred crystals without being able to detect any other form.

The colour of the triple prussiate, as prepared in Mr. Macintosh's manufactory, is a fine topaz yellow. It is transparent, and when held between the eye and the light, appears green. Its specific gravity is 1·833. Its taste is saline and cooling, and by no means disagreeable. It is not brittle like many other crystals, but splits into plates parallel to the bases of its pyramids, and these plates admit of being bent without breaking. *Three cleavages* may be perceived in it; one very distinct, parallel to the base; the two others much more obscure, and parallel to two contiguous sides of the pyramids, or to two of the bevelled edges of the tables.

When exposed to heat, it gives out moisture, and assumes a white colour; but it does not melt, nor do the crystals lose their shape, unless the heat approaches to redness. In a red heat, the salt becomes black and alkaline; but I was not able to destroy its acid completely, even by long exposure to a red heat in a platinum crucible. The solution of it in water, though very alkaline, still continued to strike a blue with solutions of iron. Its solubility in distilled water at different temperatures is as follows:

At 54°, 100 parts of water dissolve 27·8 of the salt.
100 ——— 65·8
150 ——— 87·6
200 ——— 90·6

The solubility does not seem to increase much by any augmentation of temperature which I was able to try beyond 200°.

It is insoluble in alcohol. My mode of determining the solubility of salts in water and alcohol is as follows: I put a certain volume of water or alcohol into a graduated tube, and suspend a crystal in the tube. If the crystal be soluble, a current of liquid may be perceived running down from the crystal to the bottom of the tube. If it be insoluble, no such current is visible.

2. When the salt in the state of a fine powder is mixed with sulphuric acid of the specific gravity 1·844, it becomes immediately very white, owing to the acid abstracting its water of crystallization. In a few minutes a considerable heat is evolved, and the salt begins to dissolve. If we apply the heat of a lamp, a strong effervescence takes place, and gas is extricated in abundance. At the same time the upper surface of the mixture becomes dark blue, owing to the formation of a portion of prussian blue. If the gas be received over mercury, a blue liquid is soon deposited, consisting of water strongly impregnated with sulphuric acid, and mixed, or rather thickened with prussian blue. The gas thus received contains a mixture of sulphurous acid gas; but it consists chiefly of a colourless gas having a peculiar smell, not sensibly absorbed by water, and burning very readily with a deep blue flame. From 50 grains of triple prussiate, and a drachm measure of sulphuric acid, I obtained 36 cubic inches of this gas, and the evolution did not stop till the mixture in the retort had become quite dry.

This gas may be obtained in great purity by receiving it in glass jars inverted on the water trough. Two hundred grains of the salt mixed with four drachm measures of sulphuric acid will furnish a quantity of gas amply sufficient to determine all its properties. When the dry mass in the retort is dissolved in water and filtered, 25·8 grains of prussian blue remain on the filter. The liquid that passes through has a yellow colour, and a slightly acidulous taste. It contains no traces of prussic acid, nor of ammonia; but is merely a solution of bisulphate of potash and persulphate of iron.

The gas thus obtained has a peculiar smell, not disagreeable, nor strong; but which I can compare to nothing else. Its taste is rather aromatic, and it leaves a hot impression in the mouth, which continues for some time. It is not altered by standing over water exposed to the light. Its specific gravity is 0·993, that of common air being reckoned 1·000. It burns readily when brought in contact with the flame of a candle, and the flame has a deep blue colour. It detonates readily by the electric spark when mixed with oxygen gas. I made a good many trials this way in order to determine the proportion of oxygen necessary to consume it completely, the change of bulk that takes place after the explosion, and the new products formed. These experiments were made partly over water and partly over mercury. The results were so simple that they will be readily understood without transcribing a tabular view of the trials, which were 12 in number.

Three volumes of the gas require for complete combustion two volumes of oxygen gas. The residue after the detonation, is three volumes, which consists entirely of carbonic acid gas. Thus on complete combustion the whole oxygen disappears, and the bulk of the inflammable gas is not altered; but it is totally converted into carbonic acid gas.

From these facts, it is evident that the inflammable gas is a compound of

$$\left.\begin{array}{l}\text{3 volumes carbonic oxide}\\ \text{1 volume hydrogen gas}\end{array}\right\}\text{condensed into three volumes.}$$

One and a half volume of the oxygen is employed in converting the carbonic oxide into carbonic acid. The remaining half volume of oxygen combines with the volume of hydrogen, and is converted into water. The specific gravity of such a compound is by calculation 0·995. Now this almost agrees with that of our gas, which was found experimentally to be 0·993.

This gas possessing peculiar properties must be considered as a new species. From its composition it may be denominated *hydrogureted carbonic oxide*. The result of the analysis of this gas occasioned some surprize at first; for I was not prepared to expect a gaseous compound of hydrogen and carbonic oxide. But when we consider the vast number of vegetable bodies composed of oxygen, carbon, and hydrogen, we cannot hesitate to admit that these substances are capable of uniting with each other in a great many proportions. The great variety of inflammable gases obtained during the analysis of vegetable bodies and coal, is but imperfectly explained by supposing it composed of *mixtures of the* three gases already known. This is probably only the first of a series of more complicated inflammable gases that will be hereafter discovered.

The evolution of *hydrogureted carbonic oxide* by the action of sulphuric acid on triple prussiate of potash is both a curious and unexpected fact. It renders Mr. Porrett's opinion that hydrogen is a constituent of ferrureted chyazic acid exceedingly probable; for there is no other source of the hydrogen except the water with which the sulphuric acid was united. A gas evolved from triple prussiate of potash containing oxygen was altogether unexpected, as the ferrureted chyazic acid seems destitute of that principle altogether. The oxygen was obviously derived from the sulphuric acid. This is clearly shown by the evolution of the sulphurous acid which accompanied the *hydrogureted carbonic oxide*. But the conversion of carbon into carbonic oxide, and the union of this carbonic oxide with hydrogen, have never been observed in any other action of bodies containing carbon or sulphuric acid. If this gas were to indicate the proportion of carbon and hydrogen, which exist in ferrureted chyazic acid, it would follow that they are to each other as three atoms to one atom; but as the whole acid is not decomposed, we can draw no conclusion. What becomes of the azote which is undoubtedly a constituent of ferrureted chyazic acid? It is obvious that the whole action of the sulphuric acid is not confined to the carbon. It acts also on the iron, converting it into peroxide, as is evident from the prussian blue formed, and from the persulphate of iron found in the retort.

3. The action of nitric acid upon the triple prussiate of potash varies so much with the strength and the proportion of acid employed, and the degree of heat applied, that I have hitherto but imperfectly studied the phenomena. My chief object was the analysis of the salt, and I found nitric acid a most useful reagent for that purpose. But it may be worth while to transcribe some of the most striking observations which I noted down.

When triple prussiate of potash is mixed with about twice its weight of concentrated nitric acid, it becomes immediately of a light blue colour, indicating the sudden formation of a portion of prussian blue. Heat is evolved, and gas extricated in great abundance. In a few minutes the extrication of gas stops, and the whole of the salt is dissolved in the acid, constituting an opaque liquid of a very dark brown colour. I kept this liquid for more than a week without perceiving any alteration in it. Ammonia renders its colour much lighter, and occasions a dark precipitate, which, when well washed and dried, is a black, tasteless powder, composed entirely of a mixture of prussian blue and peroxide of iron; for muriatic acid by digestion on it acquires a yellow colour, and holds peroxide of iron in solution, while a portion of prussian blue remains undissolved.

If heat be applied to the dark-coloured liquid, consisting of the solution of triple prussiate of potash in nitric acid, an effervescence speedily commences, and gas is extricated copiously. After some time, the liquid in the retort becomes viscid, and swells so much that considerable caution is requisite to regulate the heat so as to prevent on the one hand part of the contents of the retort from being driven out of the vessel, and on the other to guard against the water making its way into the retort and diluting the mixture. In a few minutes this viscidity disappears, the matter in the retort becomes manifestly a mixture of solid and liquid matter, and the evolution of gas still continues. When the portion of liquid present is diminished to a certain extent, the matter in the retort catches fire, and burns at intervals with considerable brilliancy. The extrication of gas still continues mixed with white vapours and red coloured fumes, owing obviously to a mixture of aqueous vapour and nitrous acid. When the evolution of gas is completely at an end, nothing remains in the retort but a spongy mass, having the appearance of rust of iron. It is a mixture of nitre and peroxide of iron. If water be poured into the retort, the nitre dissolves, and may be obtained by evaporating that liquid, while the peroxide of iron subsides in the form of a red powder.

The proportion of gas formed, and even its nature, seems to be influenced by the degree of heat applied, and, perhaps, also by the proportion of nitric acid. From 50 grains of the triple prussiate treated in this way, I obtained over mercury 50 cubic inches of gas, and the whole gas was not collected. In another experiment from 200 grains of triple prussiate, I obtained over water 250·5 cubic inches of gas. The first portions of gas that come over are pure cyanogen; at least they have the smell of that gas, burn with the same coloured flame, and are absorbable by water. The succeeding portions which are evolved after the application of heat contain likewise cyanogen; but they consist chiefly of azote, carbonic acid, and nitrous gas. It would appear that the prussic acid is completely decomposed; the carbon and hydrogen are converted respectively into carbonic acid and water, while the azote is evolved in the state of gas. In one experiment I collected, after the evolution of the cyanogen over mercury, 10 cubic inches of an inflammable gas, which burned with a bluish white flame, and gave out but little light. This gas seemed to possess peculiar properties, but I did not examine it with sufficient care to determine its composition.

The 250·5 cubic inches of gas were collected over water in four separate glass jars. The first jar contained 10 cubic inches of gas, the second, 35; the third, 145; and the fourth, 60·5 cubic inches. All of these jars, except the last (collected during the combustion of the matter in the retort), smelled so strong of cyanogen that the odour could not be supported. The first jar contained no carbonic acid gas; the second jar contained 52·2 per cent of it; the third jar, 40 per cent; and the fourth jar, 47·6 per cent. The third and fourth jars contained respectively 15 and 20 per cent. of nitrous gas. The remainder of the gas possessed the properties of azote.

4. It is well known to chemists, from preceding experiments, that the triple prussiate of potash contains the following ingredients;

1. Water.
2. Potash.
3. An acid composed of iron united to the constituents of prussic acid.

I shall relate the experiments to which I subjected it in order to determine the proportions of these different constituents.

(1.) *Water.*—When the salt is exposed to a gentle heat, it becomes white, owing to the escape of its water; and it gradually loses its transparency and becomes opaque; but it does not fall to powder, nor lose its crystalline form. If we heat the salt in a retort, the water passes over into the receiver. It is colourless and tasteless, if two much heat has not been applied; but if the heat has been too great, a portion of the acid is decomposed, and the water acquires a slightly saline taste. The salt in that case is not completely soluble in water, but leaves behind it a dark brown insoluble residue. One hundred grains of the salt when kept for an hour in a strong red heat lose 23·2 grains of their weight; but a considerable portion of the acid is destroyed, for the salt has become strongly alkaline, though it still continues to strike a blue with persulphate of iron. The greatest quantity of water which I was able to separate from this salt, without altering its nature, was 13 per cent. When the loss of weight amounted to 14 per cent. the salt was never quite soluble in water, a sensible portion of brown insoluble matter always remaining behind. I think, therefore, we may conclude, that triple prussiate of potash when regularly crystallized contains 13 per cent. of water.

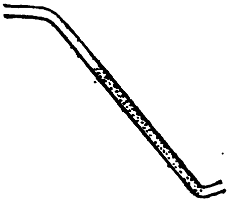
(2.) *Potash.*—When a given weight of triple prussiate of potash is treated with nitric or sulphuric acid and heated till the acid of the salt is completely decomposed, if we digest the residue in water, filter and evaporate, we obtain a salt, which in the first case is *nitre*; and in the second, *bisulphate of potash.* This last salt may be converted into *sulphate of potash* by exposure to a strong heat. I conceive that the proportion of potash in the triple prussiate may be determined with sufficient precision by ascertaining the weight of nitre or of sulphate of potash that may be obtained from a given weight of it. By three successive experiments I ascertained that the nitre obtainable from 100 grains of the triple prussiate weighed 88·5 grains. Now this is equivalent to 41·64 grains of potash. I tried some experiments with sulphuric acid to obtain the potash in the state of sulphate of potash; but did not find this method quite so accurate. The average quantity of sulphate of potash obtained from 100 grains of the triple prussiate, was 80·5 grains, indicating 43·9 grains of potash; but this sulphate was contaminated with peroxide of iron, which accounts for its too great weight. I am disposed, therefore, to rely on the analysis by means of nitric acid, and to conclude that 100 grains of crystallized triple prussiate of potash contain 41·64 grains of potash.

(3.) *Iron.*—It is exceedingly difficult to collect the whole of the iron which this salt contains; because a portion of it is volatilized when heat is applied to a mixture of triple prussiate and nitric or sulphuric acid. Even the heat evolved by the bare contact of nitric acid is sufficient to volatilize a sensible quantity of iron; for when I poured nitric acid on the salt from a phial, the whole acid in the phial acquired a blue colour, and deposited a sensible quantity of prussian blue. I made ten successive experiments with considerable care; but the first three results did not correspond well with each other. The remaining seven were conducted in retorts, the beaks of which were plunged into receivers, or dipped into the mercurial trough, while the gas evolved was collected in glass jars. These precautions enabled me to determine the portion of iron which escaped during the process. The smallest quantity of peroxide of iron which I obtained in this way from 100 grains of the salt was 19·2; and the greatest quantity was 22·5 grains. The mean of seven experiments gives 21·33 grains.

After the evidence brought forward by Mr. Porrett, I think that no reasonable doubt can be entertained that the iron in this salt is in the metallic state. If we take the mean of the preceding experiments as the true quantity of oxide of iron, the metallic iron in 100 grains of triple prussiate of potash will be 14·22 grains. But in the present case I am rather disposed to take the maximum quantity as the nearest approximation to the truth; because the collection of the whole iron is attended with peculiar difficulty, and because the experiment which gave only 19·2 grains was a solitary one, all the others giving 21, 22, or 22·5. Now 22·5 grains of peroxide of iron is equivalent to 15 grains of metallic iron, which, therefore, I consider as the quantity of iron contained in 100 grains of the triple prussiate.

(4.) *Remaining Constituents of the Acid.*—To determine the other constituents of the complicated acid of this salt, I had recourse to a method originally suggested by Gay-Lussac, and which has been since employed by Vauquelin, Berard, Prout, and, perhaps, other chemists. It seems to answer very well for the analysis of bodies composed of azote, united to carbon and hydrogen. The method is to mix a determinate quantity of the substance to be analysed with fresh calcined peroxide of copper, to put the mixture into a glass tube, and expose it to a heat gradually raised to redness. To the glass tube containing the mixture, another tube is luted filled with dry muriate of lime.

This tube is plunged into the mercurial trough; and the gas extricated during the application of the heat is collected in glass jars. The bulk of this gas being ascertained, a quantity of caustic potash is let up into it. This absorbs the carbonic acid gas. The residual gas in the present case, is azote. The increase of weight in the muriate of lime gives the quantity of water evolved. In making this experiment, easy as it may seem, some precautions are to be taken in order to ensure accuracy. I found that the results did not correspond well with each other, unless the peroxide of copper be at least 20 times the weight of the triple salt. I usually mixed 120 grains of peroxide of copper with five grains of the triple salt. The salt was in its usual crystallized state. I reduced it to a fine powder, and mixed it intimately with the peroxide of copper. Glass tubes are liable to melt if the heat employed be a little too great. I found experiments made with them rather tedious and uncertain. I, therefore, got a solid copper rod of the requisite diameter bored into a tube. It was a foot long. The mixture of peroxide of copper and triple salt filled six inches of it. The remaining six inches I filled with peroxide of copper. To keep the peroxide from being driven out of the tube, or mixing with the muriate of lime in the glass tube, I filled up the end of the copper tube with amianthus. To the extremity of the copper tube was luted with fat lute a glass tube, bent as in the margin. That portion of it which is marked with dots was filled with dry powdered muriate of lime. The whole upper part of it and the lower extremity was filled with amianthus. After being accurately weighed, it was luted to the copper tube. The copper tube was placed in a small chauffer, and so poised that about eight inches of it were within the chauffer, the remaining four inches were without. This exterior portion was covered with a thick coating of wet clay in order to keep it cool. The chauffer was then filled with charcoal, and a sufficient fire raised to heat the copper tube to redness. The portion of the tube without the chauffer was screened from the heat. Its temperature became somewhat higher than 212°, but not sufficiently so to alter the lute, which I found after the process just as entire as at first. I found it requisite to leave a portion of the glass tube empty of muriate of lime; because when that salt filled the whole of the tube, the portion of it in the immediate neighbourhood of the copper tube was apt to melt, and block up the tube so that the gas could not continue to pass. I preferred using the triple prussiate in its crystallized state, because it was easy to make an allowance for the water which it contained; whereas had I dried it, I ran the risk of altering the nature of the very consti-



uents which I wished to ascertain. I usually left the caustic potash in contact with the gas for 24 hours.

Five grains of the triple prussiate when decomposed in this way gave out 7·625 cubic inches of gas at the temperature of 60°, and under a pressure of 30 inches of mercury: 5·205 cubic inches of this gas were absorbed by potash, and were of course carbonic acid gas. The remaining 2·420 cubic inches were azotic gas. The muriate of lime had increased in weight 2·2 grains. Now if 100 grains of the salt contain 13 grains of water, it follows that five grains contain 0·65 grain; so that 1·55 grain of water had been formed by the union of the hydro gen of the salt with the oxygen of the peroxide. Hence five grains of triple prussiate contain a quantity of hydrogen equal to $\frac{1}{9}$ of 1·55 grain to 0·1722 grain. From this analysis it follows that the acid in the triple salt (not reckoning the iron) is composed of

Carbon	0·6579	42·51
Azote	0·7175	46·37
Hydrogen	0·1722	11·12
		100·00

From Gay-Lussac's analysis of cyanogen, I expected that the carbonic acid would have been exactly double the bulk of the azotic gas; but it always exceeded that amount in all my experiments (10 in number) by about the third part of a cubic inch. My glass jars were graduated to tenths of a cubic inch; and each division was of such a size that I could very well appreciate by the eye a quantity not exceeding the fiftieth part of a cubic inch. The difference cannot then be ascribed to errors in the measurement; I do not know to what cause we are to suppose it owing.

From the preceding analysis, we see that the triple prussiate of potash is composed as follows:

Acid	Iron	15·0	45·90
	Gaseous matter	30·9	
Potash			41·64
Water			13·00
			100·54

The small excess would vanish if we were to estimate the iron at only 14·22; but I am rather disposed to ascribe it to errors in the analysis. It may probably be equally divided among all the ingredients.

As the salt in question bears all the characters of a neutral salt, it is reasonable to infer that it is a compound of one atom acid and one atom base; and as an atom of potash weighs six, it follows that an atom of Mr. Porrett's ferrureted chyazic acid weighs 6·611. The equivalent number for this acid, derived from Mr. Porrett's analysis of the ferrureted chyazate of barytes, is 6·813.

We see from the preceding analysis that one third part of the weight of the acid consists of iron, while two thirds of its weight consists of carbon, azote, and hydrogen. The smallest number of atoms, which agrees nearly with the preceding proportions of the ingredients, is the following:

2 atoms carbon	= 1·5	41·379
1 atom azote	= 1·75	48·277
3 atoms hydrogen	= 0·375	10·344
	3·625	100·000

This differs from the constitution of hydrocyanic acid by containing two additional atoms of hydrogen. But I consider the proportion of hydrogen in the salt as the part of the whole which is ascertained with the least precision. I conceive it to be very difficult, if not impossible, to determine the quantity of water of crystallization in a salt which cannot be exposed to a red heat without undergoing incipient decomposition. I think it possible likewise that a slip of cork which was interposed between the glass tube and the copper tube, though extremely small, and though not apparently altered in its texture by the process, might, as it was always exposed to a temperature rather exceeding 212°, have given out a portion of the water, which had augmented the weight of the muriate of lime. These reasons induce me to suspect that the acid in the triple prussiate is hydrocyanic acid united to iron.

As to the ferruginous ingredient, it is difficult to form an accurate idea of the state of combination in which it exists in this acid. We have seen that its weight is to that of the hydrocyanic acid as one to two. Now an atom of hydrocyanic acid weighs 3·325, and an atom of iron weighs 3·5. Of course if the ferrureted chyazic acid were a compound of an atom of hydrocyanic acid and an atom of iron, the weight of the iron would exceed that of the hydrocyanic acid. If we were to suppose an atom of hydrocyanic acid to be united in the ferrureted chyazic acid with half an atom of iron, then the weight would be as follows:

Hydrocyanic acid	3·325
Iron	1·75
	5·075

a weight which does not accord with the equivalent number for ferrureted chyazic acid, as deduced from the preceding analysis; namely, 6·611. In fact, the weight of the acid indicates a compound of one atom of hydrocyanic acid and one atom of iron.

1 atom hydrocyanic acid.	3·325
1 atom iron	3·5
	6·825

But the quantity of iron really present is only one half of what this weight would indicate. This is the first compound which I have met with that does not seem reconcilable to the atomic theory. I invite chemists to the further investigation of it. There are no facts so likely to lead to the improvement of the science of chemistry as those which contradict our received opinions.

Glasgow, June 1, 1818.

Article V.

On a Substance from Coal Tar. By J. Syme, Esq.

(To Dr. Thomson.)

SIR, *Edinburgh, March 5, 1818.*

I take the liberty of sending you an account of a valuable substance which may be obtained from coal tar.

If you think it worthy of being made public, you will oblige me by inserting it in your *Annals of Philosophy*.

I am, Sir, your most obedient servant,
J. Syme.

As coal tar in every respect bears the strongest resemblance to petroleum, it occurred to me that by distilling it a fluid might be procured which, like naphtha, should have the property of dissolving caoutchouc, and that in this way I should procure a solvent free from the objections to which the known solvents of that remarkable substance are all more or less liable.

To ascertain this, I subjected a quantity of coal tar to distillation in a glass retort and receiver with a moderate heat. When the fluid which came over amounted in bulk to about one third of the tar operated on, I put a stop to the process.

Upon examining the product, I found that it was not homogeneous, but consisted of two differently coloured fluids, quite distinct (as oil and water from each other when allowed to remain together without agitation), and which consisted in nearly equal quantities.

Having separated these in the common way, by means of a funnel, I examined the properties of each. The one supernatant was of a dark amber colour, and had a strong, peculiar, penetrating odour. A piece of paper soaked in it when inflamed burned with much flame and smoke. Acids acted on it as on naphtha, giving it the appearance of petroleum. The other fluid was colourless, uninflammable, had a strong ammoniacal odour, and effervesced with acids; in short, seemed to be some of the ammoniacal fluid, produced during the distillation of the coal, from which it is very difficult to free the tar entirely.

I redistilled the first mentioned fluid, and obtained a light straw coloured oil, very inflammable, having a strong and peculiar smell, and extremely volatile. A little of it rubbed on the hand evaporated almost instantly, leaving the part quite dry. Its specific gravity I found to be about ·770; thus showing all the properties of naphtha in a state of purity.

I next proceeded to try the effects of this naphtha on caoutchouc. For this purpose I selected that kind of it which is met with in the shops, of a white colour, and in form of a cake. Some slips of this being put into a bottle and covered with the naphtha, soon began to swell, and in a few hours were in such a state that upon being stirred they cohered together, and formed a homogeneous mass.

I found that this mass might be brought to any degree of fluidity by the addition of the naphtha. When a little of this solution was exposed to the air, the naphtha speedily evaporated, leaving the caoutchouc, which in a short time resumed its original elasticity.

Therefore, I think that I may with confidence recommend this fluid as being free from all the disadvantages of the hitherto known solvents of that substance; and I hope that it may be the means of extending its use to the many purposes for which it is so peculiarly well adapted.

ARTICLE VI.

Researches upon the Action of Borax, the Boracic Acid, and the neutral Borates upon the acidulous Tartrates of Potash and Soda. By M. Vogel.*

THE author divides his memoir into two sections; in the first, he examines the action of borax upon cream of tartar; and in the second, he describes the phenomena which take place when we treat the cream of tartar and the acidulous tartrate of soda with boracic acid and the neutral borates. The best proportions for combining the cream of tartar and borax are three parts of the first to one of the last; if these bodies be boiled for a few minutes with a sufficient quantity of water, a portion of tartrate of lime is separated; a quantity of this salt still, however, remains dissolved in the fluid. When the fluid is evaporated, a salt is obtained which weighs $\frac{1}{8}$ less than the materials employed; this partly depends upon the tartrate of lime that is precipitated, and partly upon the water of crystallization in the cream of tartar and borax. The soluble cream of tartar which is obtained by this process is deliquescent; it dissolves in its own weight of boiling water at 54·5°, and in half its weight of boiling water. Its solution is very imperfectly decomposed by the sulphuric, nitric, and muriatic acids; a very small proportion of the boracic acid is separated, another portion is kept dissolved in the liquor, but the greatest part of it remains combined with the tartar.

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* Abstracted from a memoir read to the Royal Academy of Munich.—Journ. Pharm. iii. 1. (Jan. 1817.)

M. Vogel shows in the second section of his memoir, that four parts of cream of tartar and one part of boracic acid are the only proportions that we can employ, in order to obtain a salt, in which neither the boracic nor tartaric acids should be in excess. When the soluble cream of tartar is prepared in this way, it is not acted upon by boiling alcohol; while if a larger proportion of boracic acid be employed, the uncombined acid is taken up by the alcohol; and if a larger proportion of tartar be used, the excess is deposited by cooling. When a very highly concentrated boiling solution is poured into a cold vessel, a yellow, transparent, brittle mass is formed, which is a hydrate, containing ·34 of water. The soluble cream of tartar calcined at a red heat in a platina crucible leaves a residuum of borate of lime, and borate and carbonate of potash. If boracic acid be dissolved in alcohol, and the fluid be distilled, $\frac{1}{5}$ part of the acid is volatilized, a circumstance which must be attended to in the analysis of minerals. The soluble cream of tartar is considered to be a chemical compound of 80 parts tartar and 20 boracic acid.

It has been doubted by chemists whether a proper combination can be formed between the boracic and the tartaric acids, and the author is disposed to think that it can not take place. The other alkaline borates, as well as borax, produce, by the addition of tartar, a salt which is very soluble, very acid, and deliquescent. None of the borates are deliquescent, a circumstance which proves that the solubility of the compound of cream of tartar and borax is not the immediate effect of the addition of a neutral borate; the union is a chemical one, and is attended by the development of new properties in the substance produced. Alum has, in some measure, the same effect, of giving solubility to cream of tartar, by being combined with it; this observation was first made by M. Berthollet, and has been more fully developed by MM. Thenard and Roard.

The acidulous tartrate of soda was first formed by M. Berthollet in 1776, and has been particularly attended to by M. Bucholz; it is dissolved in 12 parts of cold water; by the union of boracic acid and the borates, the salt becomes very acid, and is soluble in half its weight of water; with the boracic acid it forms a very deliquescent compound. In general, the action of borax and the different borates upon the supertartrate of soda is very similar to that upon the cream of tartar.

We have some observations on the formation of the soluble cream of tartar by M. Meyrac; he gives the following process. One hundred grains of supertartrate of potash and 400 grains of water are first boiled together, 12½ grains of vitrified boracic acid are then added and boiled for some minutes, the supertartrate is dissolved, most of the tartrate of lime is precipitated, the fluid is filtered when cold, the liquor evaporated to dryness, and the salt which is obtained reduced to fine powder. An addition of ⅛ part of boracic acid is necessary; if less be added, the cream of tartar loses much of its solubility, and the solution can only be effected by protracting the ebullition. If the solution of the soluble cream of tartar be exposed for some days under a receiver enclosing lime, crystals may be procured, but they are too small for their form to be perceptible.

ARTICLE VII.

On the Milk of the Cow Tree, and on vegetable Milk in General. By M. Humboldt.*

M. HUMBOLDT and his companions, in the course of their travels, heard an account of a tree which grows in the valleys of Aragua, the juice of which is a nourishing milk, and which, from that circumstance, has received the name of the cow tree. As the milky juices of plants are in general acrid, bitter, and even poisonous, M. Humboldt was at first scarcely disposed to credit the account, but experience proved it to be correct.

The tree in its general aspect resembles the chrysophyllum cainito; its leaves are oblong, pointed, leathery, and alternate, marked with lateral veins, projecting downwards, they are parallel, and are ten inches long. M. Humboldt had no opportunity of seeing the flower; the fruit is somewhat fleshy, and contains one or sometimes two nuts. When incisions are made into the trunk, it discharges abundantly a glutinous milk, moderately thick, without any acridness, and exhaling an agreeable balsamic odour. The travellers drank considerable quantities of it without experiencing any injurious effects; its viscidity only rendering it rather unpleasant. The superintendent of the plantation assured them that the negroes acquire flesh during the season in which the cow-tree yields the greatest quantity of milk.

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* Abridged from an essay in Ann. de Chim. for Feb. 1818, which is an extract from a memoir read to the Academy of Sciences.

When this fluid is exposed to the air, perhaps, in consequence of the absorption of the oxygen of the atmosphere, its surface becomes covered with membranes of a substance that appears to be of a decided animal nature, yellowish, thready, and of a cheesy consistence. These membranes, when separated from the more aqueous part of the fluid, are almôst as elastic as caoutchouc; but at the same time they are as much disposed to become putrid as gelatine. The natives give the name of cheese to the coagulum, which is separated by the contact of the air; in the course of five or six days it becomes sour. The milk, kept for some time in a corked phial, had deposited a little coagulum, and still exhaled its balsamic odour. If the recent juice be mixed with cold water, the coagulum is formed in small quantity only; but the separation of the viscid membranes occurs when it is placed in contact with nitric acid.

This remarkable tree seems to be peculiar to the Cordilliere du Littoral, especially from Barbula to the lake of Maracaybo. There are likewise some traces of it near the village of San Mateo; and, according to the account of M. Bredmeyer, in the valley of Caucagua, three days' journey to the east of the Caraccas. This naturalist has likewise described the vegetable milk of the cow tree as possessing an agreeable flavour and an aromatic odour: the natives of Caucagua call it the milk tree.

M. Humboldt offers some general observations upon the milky juices of plants, and concludes with some particular observations upon the fluid which is procured from the carica papaya; this has been analyzed by M. Vauquelin;* but the specimen which he examined had had its properties altered by having been conveyed to a great distance, and kept for a long time.

The younger is the fruit of the papaw, the more milk does it yield; in proportion as the fruit ripens, the milk, which is less abundant, becomes more watery: there is then less of that animal matter which is coagulable by acids and by the absorption of oxygen. When nitric acid is poured drop by drop into the milky juice procured from a very young fruit, a very extraordinary phenomenon is observed. In the centre of each drop there is formed a gelatinous pellicule, divided by greyish striæ; these striæ are merely the juice which is rendered more watery, because the contact of the acid has caused it to lose its albumen. At the same time the centre of the pellicule becomes opaque, and of the colour of the yolk of the egg; while it increases in bulk by the prolongation of the diverging fibres. The whole fluid at first has the appearance of an agate with milky clouds; and it appears as if organic membranes were produced under the eye. When the coagulum is moved, it becomes granulated like soft cheese; the yellow colour is reproduced by adding a few more drops of nitric acid. The acid in this case acts in the same manner with the oxygen of the atmosphere, at the temperature of from 80·5 to 95° (Far.); for the white coagulum becomes yellow in two or three minutes by exposure to the sun. After some hours, the yellow colour turns brown, undoubtedly because the carbon is more liberated in proportion as the hydrogen, with which it was combined, is burned. The coagulum formed by the acid becomes viscid, and acquires the waxy odour, which is perceived when the muscular fibre or fungi are treated with nitric acid. From the interesting experiments of Mr. Hatchett, it may be supposed that in this case the albumen is partially converted to the state of gelatine.

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* Ann. de Chim. xliii. 267.

When the coagulum of the papaw is thrown into water, it softens, becomes partially dissolved, and gives the water a yellowish tinge; the milk, when placed in contact with water, also forms membranes; a tremulous jelly, similar to starch, is immediately precipitated, and the appearance is more remarkable if we employ water at the temperature of from about 100° to 140° (Far.) If carbonate of soda be added to the fluid, the coagulum is not formed; but it is immediately produced by the addition of an acid. If we compare together the milky juices of the papaw, the cow tree, and the hævea caoutchouc, we find a striking resemblance between the juices which abound in caseous matter, and those in which the caoutchouc predominates. According to the opinion of M. Gay-Lussac, we may consider the caoutchouc as analogous to the oily part or the butter of the vegetable milk; in the vegetable milk we find caseum and caoutchouc; in animal milk, caseum and butter. The albuminous and the oily principles exist in different proportions in the different species of animals and milky plants; and in the last, they are frequently united to other substances which render them injurious as articles of food.

ARTICLE VIII.

On Magnetism considered as a Method of detecting the Presence of Iron in Minerals. By M. Haüy.[*]

THE magnetic property of iron serves as a method of detecting the presence of this metal, which possesses the two-fold advantage of being decisive and easy of application. In some cases the iron exists in a state which enables it to be directly acted upon by the magnet; but in other minerals it is either oxidated, or it is combined with some principle which deprives it of its magnetic power, as, for example, in arsenuretted or sulphuretted iron; it is then necessary to heat a small fragment of the mineral in the flame of a taper, in order to render it magnetic; sometimes the action of the blow-pipe is required, but it may generally be dispensed with. To perform these experiments with success, we must procure a highly magnetized needle, furnished with a cap of agate or rock crystal, and supported on a very delicate point.

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[*] Abridged from Ann. des Mines, 1817, p. 329.

In order to understand the method which M. Haüy adops in exhibiting small quantities of magnetism, the principle is explained by which the needle is preserved in the magnetic meridian. Suppose the needle to be in our hemisphere, where it is the nearest to the north pole of the globe. The fluid which resides in this pole acts by its attraction for the south pole of the needle, and its repulsion for its north pole; the reverse takes place with respect to the south pole of the globe; but because it is more remote, we may consider the needle as influenced solely by the force of the north pole of the globe, in proportion to the excess of this force over that of the other pole. If we conceive that the needle is removed a little from the plain of its magnetic meridian, its *directing* force will immediately act in order to restore it; it has been proved by M. Coulomb, that this directing force is proportional to the sine of the angle which the needle makes when removed from its natural direction with the natural direction, that is with the magnetic meridian. Before any body which is presented to the needle can act upon it, it will have to overcome this directing force as well as the little degree of resistance which the needle must experience at the point of suspension; and we may easily conceive that the quantity which is presented to the magnet may be too small to overcome the sum of both these forces, and that the needle will, therefore, remain immovable.

From reflecting on these circumstances, the author conceived the idea of diminishing the force opposed to the action of the needle, so that it would detect portions of iron too small to be sensible by the ordinary means. To accomplish this object, he places a magnetic bar at a certain distance from the needle on the same level, and in the direction of its axis, and with its poles situated contrary to those of the needle. If we suppose the magnetic bar to be placed to the south of the needle, the south poles of the magnet and the needle will be opposed to each other; and if we cause the magnet to approach the needle, the needle will move on its centre, towards one side or the other, until an equilibrium is produced between the action of the magnet and the needle on each other, and that which exists between the needle and the earth. It follows from the law which was laid down by Coulomb, that in proportion as the needle deviates from its natural position, the increments of power necessary to produce the same effect upon it are in a decreasing ratio; so that when it has moved through nearly a quarter of the circle, a very small attractive power will be sufficient to influence it. When it is in this position, that is, nearly at an angle of 90° with the magnetic meridian, the needle is in its most sensible state; and if we apply to it the most minute portion of any mineral containing iron, the needle is affected by it. By proceeding upon this plan, M. Haüy was enabled to detect iron in several minerals where it had either not been suspected, or was supposed to exist in a state not liable to be affected by the magnet.

ARTICLE IX.

Analysis of the Gases found in the Abdomen and Intestines of an Elephant. By M. Vauquelin.*

In March last an elephant died at the museum of natural history in Paris; and its abdomen becoming very much enlarged after death, M. Vauquelin undertook to examine the state of the gas which distended it, as well as that contained in the intestines. The gas in the abdomen had a very fœtid odour of putrid animal matter, mixed with that of sulphuretted hydrogen. Caustic potash produced a diminution of about 55 hundred parts in the gas, while the potash acquired a yellow colour and fœtid odour; acetate of lead precipitated a white substance from it, which was soluble with effervescence in nitric acid. Different circumstances proved that there was a small quantity of sulphur in the gas. The gas that was left unabsorbed by the potash was no longer capable of supporting combustion; and it was therefore concluded that it consisted originally of carbonic acid gas, azote, and a minute portion of sulphuretted hydrogen, through which was diffused a little putrid animal matter.

The gas that was contained in the intestines in its sensible properties generally resembled that from the cavity of the abdomen; it also was absorbed by potash, but more copiously, nearly $\frac{3}{4}$ being removed in this way; the potash became yellow, and let fall a white precipitate by the addition of acetate of lead; there were likewise evident indications of the presence of sulphur. The entire gas from the intestines would not support flame; but it burned with a bluish white light, when the carbonic acid was removed by potash. By comparing the effect produced from detonating this gas with oxygen to that of the other hydrocarbonous gases, we find that it contains about one part of hydrogen, by weight, to four of carbon, and that it consequently composes a new variety of these gases, or at least a new mixture of the component parts.

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* Abridged from Journ. Pharm. iii. 205. (May, 1817.)

It appears from the above analysis, that the gas in the cavity of the abdomen differed considerably from that in the intestines, the latter being an hydro-carbonous gas, holding a little animal matter and sulphur in solution, and not containing azote.

M. Vauquelin has also given an analysis of a species of calculous concretion, which was found in the maxillary glands of the same animal. Some parts of it were formed into regular tetrahedral crystals, while others were amorphous, and had a grain of oat in their centre, which seemed to be a nucleus on which the matter had been deposited. By applying the proper reagents, the concretions were found to consist principally of carbonate of lime, united to a portion of phosphate of lime, and a little animal matter. The individual concretion which M. Vauquelin examined, was one that had an oat in the centre, but we are not informed whether there was any difference in the composition of the crystallized matter. The author afterwards gives us an account of some concretions which were found in the entrails of a sole; they were of a cubical form, and were found to consist of phosphate of lime united to a little magnesia. Their peculiar form is conceived not to be owing to any crystalline arrangement, but to have been mechanically impressed upon them by the cavity in which they were deposited.

Analysis of the Synovia of the Elephant. By M. Vauquelin.*

M. Margueron analyzed some years ago the synovia of the ox; and an account of his experiments was published in the Annales de Chimie, tom. xiv. p. 143. He found $\frac{4}{5}$ of it to consist of water; it contained albumen in two states, also muriate of soda, carbonate of soda, and phosphate of lime. The death of the above-mentioned elephant enabled M. Vauquelin to obtain the synovia in abundance, and he took advantage of this circumstance to repeat the examination of it.

The conclusion which is deduced from the experiments is, "that the synovia of the elephant does not differ from that of the ox; but that in the synovia of the elephant, as well as in that of the ox, there is, independently of the albumen which composes the greater part, another animal matter, which is not susceptible of being coagulated by heat or by acids, but which is coagulated by tan; unless we suppose that the properties of the albumen are modified by heat, and by the presence of the salts which are found in this humour."

M. Vauquelin differs a little from M. Margueron with respect to the nature of the salts contained in synovia; they are said to be muriate of soda and potash, and a subcarbonate of soda, without any alkaline phosphate; he supposes it, however, to contain lime, united, as we may presume, to phosphoric acid.

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* *Abridged from* Journ. Pharm. iii. 289. (July, 1817.)

Dr. Bostock had an opportunity of examining a fluid that was procured from a wound near the elbow joint, which was supposed to be synovia. It consisted of albumen partly in its fluid state, and partly in a state of half coagulation, together with the uncoagulable or muco-extractive matter, which, according to Dr. Marcet's and his experiments, is always found in albuminous fluids. The salts did not appear to Dr. Bostock to differ from those of the serum of the blood.

ARTICLE X.

Brief Account of the Imperial Society of Naturalists, at Moscow.

By Dr. Lyall, Physician to the Countess Orlof-Tchesminsky.

THE plan for forming a depot for the discoveries in natural history, in the vast empire of Russia, and uniting the friends of this science who wished to lend their assistance for that purpose, and of publishing in Russia the history of the discoveries made in the empire, was conceived by Professor Gotthelf Fischer, on his arrival at Petersburgh, in the year 1804. It was not till the summer of 1805, however, that a few of the Professors of the University of Moscow and of the literati first assembled and adopted the regulations proposed by Professor Fischer.

The object of the Society is to occupy itself with natural history and the relative sciences, as human and comparative anatomy, chemistry, natural philosophy, rural economy, &c. &c.

The Society consists of members *ordinary* and *honorary*. The ordinary members are divided into *resident* and *non-resident*. Shortly after the association above-mentioned took place, his Excellency the late Mr. Mouraviof, Curator of the University and Colleague of the Minister of Public Instruction, being informed that the Society had begun to meet at the house of the Director, Professor Fischer, presented its regulations to his Imperial Majesty, the Emperor Alexander, who approved of the plan, and, therefore, ordered Mr. Mouraviof to testify his gracious satisfaction and approbation to the Professor.

Soon after the institution of the Society, the literati, and particularly the cultivators of natural history, including many of the nobility in Petersburgh and Moscow and in the other towns and Universities in Russia; many of the most distinguished philosophers and naturalists on the continent, chiefly through the extensive acquaintance of the founder and Director, were enrolled among *its members*. Presents were received from all *quarters, of books, objects* of natural history, and money. The

Society was very flourishing; and by the year 1812, had published four volumes of its transactions in different languages. All the collections of the Society were deposited in the museum of the University; and along with that extensive collection became a common prey to the flames in the memorable year 1812. Among other things were lost some manuscripts, and almost the whole of the impression of the four volumes of the Transactions, and also the second edition of the first volume. Far from being dispirited by this irreparable misfortune, particularly to Professor Fischer, who had arranged and published a catalogue in three volumes of the Museum Demidof, and two volumes of the Imperial Museum, now united; he and the other members reassembled in 1813, began their proceedings, and since that period have continued all their efforts with unremitting vigour to recover from their losses. The Society has again collected a small museum, which has been considerably augmented this winter, as well as the library, consisting of above 300 volumes. (The library of the University is restored to the amount of 7000 volumes.)

The Society unites here a number of men of great, and others of considerable talents, whose works are too little known in Great Britain. From the change in the state of Europe, however, a more free interchange of scientific publications is to be wished for, and may be expected. The Society intends very soon to reprint the four volumes of its Transactions; and in the mean time the fifth volume is in the press, which forms the first of a new collection. The whole of these volumes is replete with matter important to the natural historian and philosopher.

The number of the Society's honorary and *non-resident ordidinary* members is very great, and includes the most distinguished characters in Europe and America, &c.

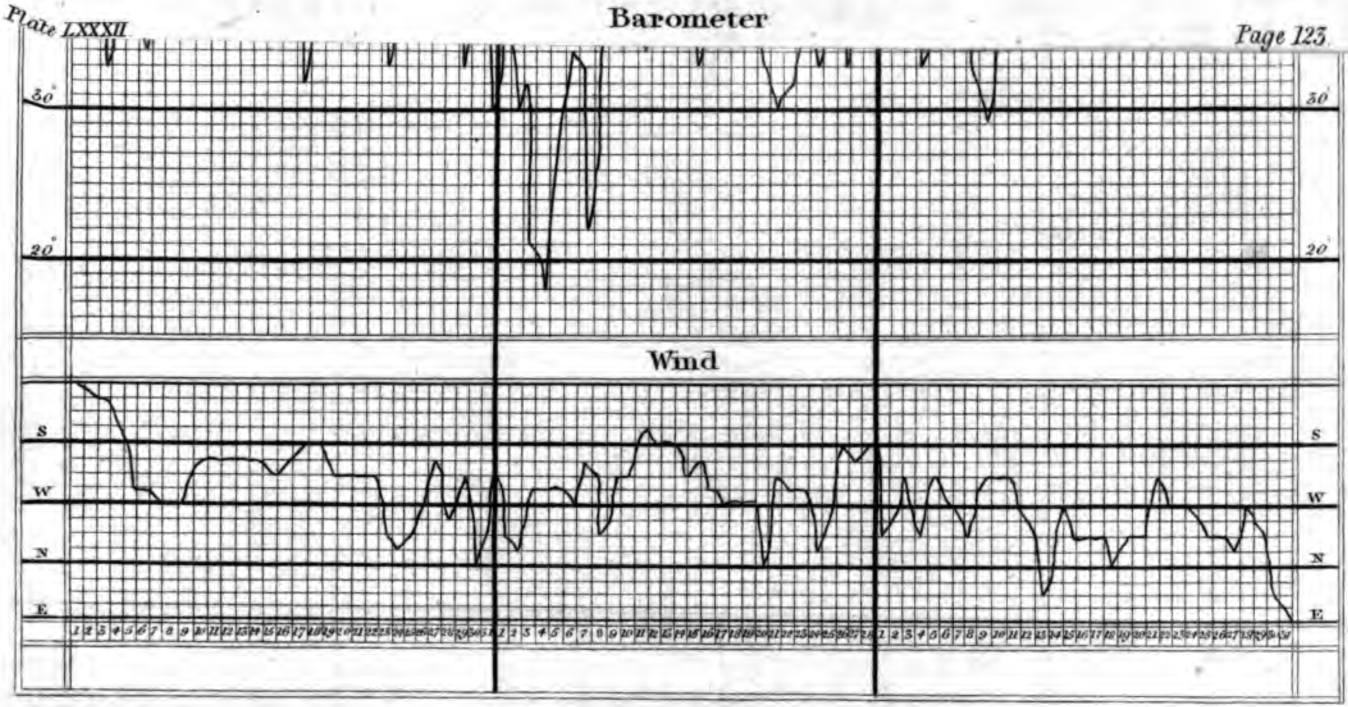
The Founder and Director, Professor Gotthelf Fischer, is a most indefatigable naturalist; and although not more than 46 years of age, the catalogue of his works and translations of different kinds occupies nearly three quarto pages, and better proclaim his character and the extent of his knowledge than any encomium I could add. But I may be permitted to say, that his private character is of the highest and most amiable kind, and that his friendship yields me the greatest pleasure and instruction.

The Society had attached the names of a number of distinguished characters in Britain before my arrival here. I proposed a few more, who have been elected.

The Imperial Society of Naturalists is well known on the continent, and is desirous of becoming better known also in Great Britain by an interchange of its Transactions for the Transactions of the Natural History and Literary Societies of our island, as well as to receive the donations of objects of natural history, or of books, from its members, or from individuals disposed to assist its views.

Plate LXXXII

Page 123



Societies wishing to make an exchange of Transactions may address themselves as follows:—"To Professor Gotthelf Fischer, at Moscow."

Or if they will send a copy of their Transactions, they may rely with perfect confidence that Professor Fischer will return in their place the works of the Imperial Society of Naturalists.

ARTICLE XI.

Meteorological Journal for the City of Cork. By T. Holt, Esq.

(To Dr. Thomson.)

SIR, *Cork, May.* 21, 1818.

I HAVE been prevented by severe illness from transmitting the annexed meteorological scale (Plate LXXXII) before this time, but trust it is not now too late for insertion in the *Annals of Philosophy* for July. I shall be enabled to complete the continuation of the scale up to June 30, so as to transmit it by July 10; and I hope in future to have every quarterly scale ready in as short a time after its completion.

Permit me to inquire, Sir, if it has been before noticed that a dilute solution of indigo in sulphuric acid, when treated with any deoxydizing subject, as bright iron or zinc filings in a closed vessel, loses its blue colour and remains colourless (or rather of a very pale green colour) so long as the vessel is kept closed? The admission of air restores the blue colour, which is again made to disappear by closing the vessel. As on the addition of the iron filings hydrogen gas is evolved, the vessel will require to be occasionally unclosed to let it escape, or it will endanger the bursting of the vessel.

With much respect, I am, Sir,
Your very obedient, humble servant,
THOMAS HOLT.

The fact related by our correspondent is, we believe, new; and may, probably, be of considerable practical utility. It is well known that indigo becomes a fast colour only when it is applied in a deoxygenated state; and this is usually effected by digesting the indigo in warm or cold water with sulphate of iron and lime. The blues, however, thus produced, are not equal in vividness of tint to the Saxon blue, which is made by digesting the indigo in sulphuric acid, by which it is dissolved without undergoing any change of colour and consequent deoxygenation. On this account the Saxon blue, however beautiful, is a colour more or less fugitive, and, therefore, inapplicable to many purposes. It is possible that by judiciously following up the hint thrown out by our correspondent, a method may be discovered of rendering the beautiful tint of the Saxon blue equally fast with the ordinary indigo dye.—ED.

REMARKS.

JANUARY.

1. Cloudy, dry day; windy evening.
2. Ditto, with high wind.
3. Snow this morning; rainy evening.
4. Bright morning; cloudy day, rainy evening.
5. Dry, bright day; light shower at noon.
6. Frost last night; bright day; foggy evening.
7. Dull, misty day.
8. Bright, dry day.
9. Moist day.
10. Dry, cloudy day; rainy evening.
11. Showery day; rainy evening.
12. Misty morning; dull day; rainy evening.
13. Great wind and rain last night, and till noon.
14. Bright morning; showery day, with wind.
15. Dull, moist day; gale of wind.
16. Heavy mist through the day; rainy evening.
17. Frost last night; bright day; rainy evening.
18. Ditto, ditto; dry evening.
19. Dull, showery day; windy evening.
20. Rainy day, with wind.
21. Bright day.
22. Rainy day; snow in evening; windy.
23. Showery day.
24, 25. Bright days.
26. Misty morning; sleet, with wind.
27. Showery day.
28. Snow showers.
29, 30. Frosty night; rainy days.
31. Hard frost last night; bright day; rainy evening.

FEBRUARY.

1. Snow last night, and through the day, with frost.
2. Ditto.
3, 4, 5. Bright, frosty days.
6. Thaw; bright day.
7. Frost last night; bright day.
8. Cloudy morning, thaw.
9. Foggy morning; bright day; occasional showers.
10. Bright day; rain last night; showery evening.
11. Frost last night; bright day; some showers.
12. Cloudy morning; rainy evening.
13. Showery day; wind.
14. Gale of wind last night; showery *day; bright evening.*
15. Frost last night; showery day; wind high.
16. Rainy night and showery day.
17. Cloudy morning; rainy evening, with wind.
18. Misty day.
19. Rainy night and morning; bright day.
20. Frost last night; showery day.
21. Great wind and rain last night; showery day.
22. Frost and snow last night: showers of hail this day.
23. Light snow last night; violent and protracted showers this day.
24. Frost and snow last night; dry morning; rainy evening.
25. Violent showers and wind.
26. Showers of snow and wind.
27. Bright day.
28. Showery and windy.

MARCH.

1. Showery and windy.
2. Rainy morning; clear day.
3, 4. Very heavy rain, with wind.
5. Frost and snow last night; heavy showers of rain and hail.
6. Bright day; a few showers.
7. Bright morning; showery day.
8. Showery day, with snow.
9. Frost, snow, and wind, last night, and this day.
10. Frost last night; showers of snow.
11. Rainy and windy day.
12. Snow last night; showery day.
13. Fine morning; showers of hail; fine, windy evening.
14. Ditto, ditto; rainy evening.
15. Fine day; some showers of rain; wet evening.
16. Dull, dry day.
17. Bright day.
18. Dull, dry day.
19. Rainy day.
20. Bright day; some hail showers.
21. Fine bright day; wet evening, with thunder and lightning.
22. Hazy day, with wind.
23. Clear day; some showers of rain and hail.
24. Bright day; some hail showers.
25. Ditto; showers of rain.
26. Ditto, ditto; gale of wind.
27. Dull, dry day.
28. Cloudy, with light showers.
29. Cloudy and showery day; fine evening; rainy night.
30. Cloudy morning; bright day; breeze.
31. Bright day.

Article XII.

On English and Foreign Copper, Zinc, and Brass. By T. Gill, Esq.

(To the Editors of the *Annals of Philosophy.*)

No. 11, *Covent Garden Chambers,*
July 14, 1818.

GENTLEMEN,

In *Dr. Thomson's History of Physical Science,* published in your *Annals* for last month, page 20, speaking of *brass,* he says, " A friend of mine in London, who excels in the construction of time-pieces, showed me a piece of brass which he valued very highly. He gave it the name of old Dutch brass, and informed me that he was in the habit of buying it up whenever he could find it, and paying much higher prices than were demanded for modern brass. He was one of those persons who have a much greater veneration for former ages than for that in which they happen to live." He then proceeds to state, that "*the old Dutch brass was much more ductile than Bristol brass with which I compared it.*" This is surely a much better reason for his friend's preference than his " veneration for former ages ; " and he is by no means singular in his opinion, and indeed is well justified in his practice by the vastly superior purity, ductility, and malleability of the old Dutch, or, more properly, Nurenberg brass, which to watch-makers is invaluable, and has long been employed by them.

The late Mr. Harrison made his celebrated time-pieces of old Dutch pan brass ; and Mr. Hardy was recently furnished with some of it by the Board of Longitude, in whose hands it had been preserved from the time of Mr. Harrison, to make a time-piece with for the Royal Observatory at Greenwich.

When it is considered that the foundation of the very superior accuracy and delicacy of finish of time-pieces and watches, rests entirely upon the excellent quality of the steel, and the purity and malleability of the brass, which they are composed of, it is by no means singular that watch-makers should prefer that brass, which so far excels every other in these important respects.

The Dutch or Nurenberg brass owes its superior properties to processes, which are very different to those followed in the manufacture of brass in this country ; and, indeed, until copper is brought to that degree of purity and malleability as to be capable of being beaten into leaves by the gold beater's process, similar to *Dutch leaf metal;* and that zinc shall be entirely freed from the lead, tin, &c. with which it may happen to be combined in the ores by other processes than those usually employed in this country, namely, *of mixing the ores of zinc with copper to make brass, or of distilling them per descensum to extract the zinc,* which also carries down with it lead, tin, &c. it will be in vain to hope to make brass equal to the old Dutch brass, and as capable of being *beaten* or *rolled* into thin *tinsel,* or drawn into fine *music wire;* articles for which we are entirely indebted to Germany.

English brass also differs very considerably from Dutch brass in its liability to become decomposed and rotten in the time of a thaw, possibly from the combined action of cold and moisture, as happened to a piano-forte making by my friend Mr. T. T. Hawkins, the frame and strings of which were so exposed when all those made of English brass wire broke, and the remains of them were become quite brittle and rotten, and the broken parts exhibited a dark coloured grain; whilst all those which were made of foreign brass wire remained unhurt.

I am, however, in hopes that this country will shortly be able to rival the Nurenberg copper and brass: my father-in-law, Mr. Wm. E. Sheffield, who has formerly been long in Germany, and paid particular attention to these important objects, and is a metallurgist of great skill and experience, *having lately manufactured copper, zinc, and brass, equal in every respect to the best foreign;* and he is now endeavouring to establish a company for the erecting of works on a large scale; so that, I trust, this country will not much longer remain under the stigma of being excelled in some of its staple articles by the superior quality of those of other nations.

Another very important advantage resulting from Mr. Sheffield's superior method of extracting *pure zinc* from its ores, is, that he can employ *with profit* those *poor ores,* yielding much less than 30 per cent. of metal, and which have hitherto been rejected by the manufacturers of brass in this country to the great loss of the miners. I am, Gentlemen,

Your most obedient servant,

THOMAS GILL.

ARTICLE XIII.

On the colouring Constituent of Roses. In a Letter to the Editors. By Edward Daniel Clarke, LL. D. Professor of Mineralogy in the University of Cambridge, &c.

GENTLEMEN,

THE doubts which have been entertained respecting the colouring principle in flowers, and especially in the blossoms of the *rose,* induced me to make a chemical examination of the substance to which their colour is due. The use to which this colouring principle has been applied in the preparation of *test* paper renders the inquiry worth a little attention; and the inferences to be deduced from it are such as may excite the curiosity of your readers. *Scheele* succeeded in proving that the ashes of vegetables contain *manganese,* whence, perhaps, originated the notion that the *red* colour of the *radish* and the *green* colour of *its leaves,* were owing to the presence of this metal. With respect, however, to the *red* colour of the petals in *roses,* I have satisfactorily ascertained that this is due entirely to *iron;* having obtained *iron* and in the *metallic* state, from an infusion of *roses* in distilled water. In proof of this, I send you a small globule of *iron* thus obtained; exhibiting a high degree of *metallic* lustre when filed, and having all other properties of the metal. The process by which the metal was extracted shall now be related; merely premising that the sort of *rose* used in these experiments, was that which botanists term *rosa gallica,* or common *red rose.*

After carefully separating the petals from their calices, the former were placed in a porcelain vessel and covered with warm distilled water which had been previously boiled in a Florence flask. In this state they were suffered to remain for eight hours, after which time the infusion was passed through a filter. A few drops of *muriatic* acid were then added, and afterwards liquid *ammonia;* when a dark precipitate immediately fell, which, upon the addition of a little more of the precipitant, and agitating the fluid, became of a leaf *green* colour. Being left for a couple of hours, a considerable subsidence appeared at the bottom of the vessel, which, collected upon a filter, assumed a *mud* colour, and in this state was left to dry. After being dried, as much of this *mud* coloured precipitate as could be taken from the filter was placed in a test tube and a little *nitro-muriatic* acid poured upon it. The acid had been previously proved, and yielded no precipitate or change of colour to *prussiated alkali.* Aided by a slight degree of heat, it became of a dark chocolate *brown* colour, and began immediately to act upon the precipitate with violent effervescence; disengaging a gaseous fluid, which I have not yet examined, and presently recovering its transparency and colour; appearing only somewhat paler. Distilled water was then added, and being placed over an Argand lamp, the whole of the liquid was evaporated, nearly to dryness. There then remained at the bottom of the tube, a *muriate of iron,* and distilled water being again added, it was dissolved. *Prussiate of potass* now threw down a beautiful emerald *green* precipitate, which, when left to subside, assumed a *blue* colour; this being collected on a filter, the remaining liquid after passing the filter exhibited a topaz *yellow* hue. As the quantity of precipitate collected upon the filter was very small, I made use of an expedient which I have found convenient in experiments upon minute portions of metallic oxides before the *gas* blow-pipe, when it was necessary to preserve the quantity as much as possible from diminution; namely, that of tearing off the lower point of the filter containing the substance to be examined, and making it up, while in a moist state, into a pellet between the fingers. This pellet was then placed within a cavity in a stick of *charcoal* and exposed to the flame of a wax candle urged with a common blow-pipe. In this state, fusion, with exceedingly *minute globules,* became apparent; and the deoxydation being aided by the addition of a little *wax*, the whole gradually ran together into a single globule of more considerable size; which remained upon the charcoal exposed to the most intense heat that could be communicated for several minutes. Being then suffered to cool, it was so powerfully attracted by the magnet, that from the preceding observations I had little doubt of its containing *iron* in the *metallic* state; and upon submitting it to the proper tests, this fact was decided. It exhibited a high degree of metallic lustre to the action of the file. As I have since repeated the experiment, and always with a similar result, I thought it might gratify your curiosity to see the *iron* thus obtained. I have, therefore, sent you one of these globules fixed into a deal splinter and filed; exhibiting an appearance like a small *iron* nail driven into the wood. But as a philosophical query suggested by the whole of the preceding inquiry, I wish to propose this question: whether the *rose* tree, among other instances of the same nature, be not in itself a living test of the presence of an *acid* and an *alkali* in the plant; the acid being manifested by the *red* colour of the parts of fructification, and the *alkali* by the *green* colour of the leaves? The mere circumstance of *oxygen* existing in a greater proportion to *hydrogen*, than is necessary to form *water*, in a vegetable substance, is sufficient to explain the presence of an *acid;* and *alkaline* bodies, being substances negatively electrified, an excess on the side of the *hydrogen*, explaining the *alkaline* character of the leaves, may thence be inferred. That the *iron* may, perhaps, exist as a *phosphate* in the flower seems to be warranted in this; that the precipitate thrown down by *ammonia* from the infusion of *roses*, when acted upon by a powerful heat, *phosphoresces;* and this compound is still more likely to be detected in those flowers exhibiting *white* and *blue* colours, because these are the hues of the native *phosphates of iron* in the mineral state. However, as the *carbonated alkalies* dissolve the *oxide of iron* with ease, and this solution, which was first noticed by *Stahl*, is decomposed by the *alkalies* in a *caustic* state, it may be the same which acts as a *colouring principle* in *roses*. That the base of it is *iron* has been here proved. If I have leisure, I will carry this investigation somewhat further; and by extending it to the *colouring principle* in other vegetable bodies, endeavour to ascertain whether *iron*, so universally prevalent, be the only *metal* to which the varied hues of flowers ought to be ascribed. Hitherto, the nature of their *colouring principle* seems to have been unknown. *Thenard* says of it, that it has not yet been obtained in a separate form, although he admits that it is almost always soluble in water. His words are,* "*Leur principe colorant n'a point encore été isolé; il est presque toujours soluble dans l'eau.*"

I have the honour to be, Gentlemen, yours faithfully,

Cambridge, July 14, 1818. EDWARD DANIEL CLARKE.

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* *Traité de Chimie*, tome troisieme (1716), p. 376. Paris, 1815.

ARTICLE XIV.

Notice respecting the Fixedness of the Boiling Point of Fluids.

By M. Gay-Lussac.*

In the memoirs of the Academy of Berlin for the year 1785, p. 2, or in the Annales de Chimie, x. 49, we have a set of experiments by M. Achard, the object of which was to ascertain whether the degree of heat of pure boiling water be fixed and invariable, independent of the pressure of the atmosphere. He deduced two conclusions from his experiments: 1. That, in a metallic vessel, water has not a fixed point of ebullition, but that, while it continues boiling, its temperature is constantly varying, and that this variation is principally produced by the action of the air, both upon the sides of the vessel and upon the surface of the water, while, in a glass vessel, boiling water has a fixed and determinate degree of heat, without the action of the external air upon the sides of the vessel producing any change in the state of the fluid. 2. That the nature of the vessel has no influence upon the degree of heat which the water acquires in boiling. There is, however, reason to suppose that M. Achard's experiments are not correct, and that they were so made that the results cannot be accurately compared together.

M. Gay-Lussac, some years ago, observed that a thermometer, which marked exactly 212 Fahr. (100 cent.) in water boiling in a vessel of tinned iron, did not stop at the same degree in a vessel of glass, although the circumstances appeared in other respects quite similar. The difference was about two degrees Fahr. and as there seemed no way of accounting for it but the nature of the vessel, he concluded that water boils sooner in a metallic than in a glass vessel.†

Prof. Munche, of Heidelberg, in conjunction with M. Gmelin, has made a number of experiments in vessels of different kinds, and nearly of the same form, the results of which he conceives are unfavourable to M. Gay-Lussac's position. Upon examining into the nature of M. Munche's experiments, M. Gay-Lussac does not, however, conceive that they afford any real objection to his former opinion; many of the results in fact coincide with it, and with respect to the rest, they do not appear sufficiently satisfactory to entitle us to form any general conclusion contrary to it.

With respect to the cause of the difference, M. Gay-Lussac conjectures that it may depend both upon the conducting power of the substance of the vessels and upon the polish of the surfaces. In illustration of the subject he states the following facts. When a mattrass half filled with water is made to boil, a considerable noise is produced, which indicates that the ebullition takes place with some difficulty; large bubbles of vapour are formed, which rise up from certain points only, and a thermometer plunged into the fluid experiences frequent variations. If we employ a vessel of tinned iron, the noise is less considerable, the bubbles are smaller, but more numerous, the variations of the thermometer are less considerable, and the boiling point is lower. We may confirm this observation by boiling water in a glass vessel, and throwing into it a few filings of iron, when the ebullition will immediately proceed in the same manner as in a metallic vessel. If we employ sulphuric acid instead of water, the difference is more considerable, amounting often to many degrees.

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* Abridged from the Ann. de Chim. et de Phys. vii. 307. (March, 1818.)

† Ann. de Chim. lxxxii. 174.

When a fluid is boiled in glass, not only is the ebullition more slow, but a thermometer plunged into the fluid experiences considerable variations, and rises above the real boiling point. It is supposed that the cohesion or viscidity of a fluid must have a considerable effect upon its boiling point; for the vapour which is formed in the interior of a fluid has two forces to overcome; the pressure upon its surface, and the cohesion of the particles. It may be supposed that a solid or a fluid body, the vapour of which is formed at its surface, may be in a state of equilibrium with the pressure of the atmosphere, while the interior portion may acquire a greater degree of heat than that of the real boiling point, provided the fluid be confined in a vessel and heated at the lower part, as generally takes place in the boiling of fluids. In this case the adhesion of the fluid to the vessel may be considered as analogous to its viscidity.

The disengagement of an elastic fluid, which is dissolved in water, is analogous to the ebullition of a fluid. If we take any brisk fermenting liquor, and wait until the escape of the gas has ceased, it may be renewed by introducing into it any solid substance, as a piece of paper, a crust of bread, a powder, or even by agitation. The carbonic acid is disengaged principally where the fluid touches the glass, and particularly at any part where there are asperities in the surface.

On this principle we explain the sudden starts which sometimes take place in the boiling of fluids. When by any means the temperature of a fluid is raised above the true boiling point, it happens that some change occurs, by which a new state of things is induced, and the superfluous heat is suddenly disengaged in the form of a great rush of steam. This frequently occurs to a great degree in distilling sulphuric acid, by which the vessels are not unfrequently broken, when they are of glass; this evil may be effectually obviated by putting into the retort some small pieces of platina wire, when the sudden disengagement of gas will be prevented, and consequently the vessels will not be liable to be broken.

The Editors have subjoined an account of Prof. Munche's experiments, which are referred to by M. Gay-Lussac in the above paper, and also an extract, on the same subject, from M. Biot's Traité de Physique.

On the Fixedness of the Boiling Point in Thermometers. By Professor Munche, of Heidelberg.[*]

It had been announced by M. Gay-Lussac, that water boils in metallic vessels at a temperature of 2·34 Fahr. (1·3 cent.) lower than in glass vessels; and M. Biot has since confirmed the observation; but the cause of so remarkable a fact has not been yet ascertained or even examined. M. Munche, in conjunction with M. Gmelin, undertook to repeat the experiments and to endeavour to give some explanation of the facts. A number of vessels of the same form were accordingly prepared, three inches high and 1·3 inch in diameter, but of different materials. Four of them, one of thick leather, another of beech wood, a third of ivory, and a fourth of 12 folds of thin paper, could not be made use of, because they were not sufficiently good conductors of heat to enable the water to boil. Those that were employed were of copper, tinned iron, tin, lead, and marble; they had also a goblet of silver and one of platina, the first ·3 line thick; the second, ·2 only; also a vessel of varnished delft ware, 1·6 inch in diameter, two cups in the form of goblets, one of porcelain and the other of Delft ware, two inches in diameter, and lastly three medicine phials, of 1¼ in diameter, one of white, the other two of green glass. The water in these different vessels was kept as nearly as possible at the same temperature, by placing them in the same sand bath. The following are some of the principal results that were obtained.

1. The heat of boiling water may be increased by the quickness of the fire, so that the thermometer may be raised more than one degree of Fahr above the boiling point on the scale. 2. When the bulb of the thermometer touches the bottom of the vessel, particularly when it is inserted between the cone which projects inwards and the sides of the vessel, the thermometer rises still higher, as much as 1·8 Fahr. 3. The heat of the water is diminished, when sand is thrown into it, by some tenths of a degree; a small quantity of copper filings, part of which swam on the water, whilst the remainder fell to the bottom, produced no effect.

The following table contains the actual temperatures which the water exhibited in the different vessels when in a state of ebullition, above or below the degree marked on the scale.

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[*] Abridged from Bibliotheque Universelle, vii. 101. (Feb. 1818); and Journal de Phys. lxxxvi. 243. (March, 1818.)

Substance of the vessels.	Temperature.	
	The thermometer touching the bottom.	When the thermometer was half an inch below the surface of the water.
Silver	− 0·225 Fahr.	− 0·45 Fahr.
Platina	− 0·225	− 1·125
Copper.	+ 0·9	+ 0·225
Tinned iron....	+ 1·24	− 0·34
Marble	+ 0·1	− 0·34
Lead.	+ 0·45	− 0·225
Tin...........	+ 0·7	− 0·225
Porcelain.	+ 0·1	− 0·1
White glass....	+ 0·7	0·0
Green glass....	+ 1·8	+ 1·35
Ditto.	+ 0·7	0·0
Delft ware	+ 1·8	+ 0·7
Common earthenware	+ 1·8	+ 0·45

The inside of the metallic vessels, although they were not very highly polished, were so much so as to have a degree of metallic lustre. The silver goblet had on one side a black spot owing to the metal having been a little acted upon in that part. As soon as the bulb of the thermometer touched this spot, it rose more than a degree of Fahr. and upon touching the bottom, it fell to the point marked in the table; this curious observation has been frequently repeated, and always with the same results.

The author explains the results of his experiments upon the principle that the heat passes through the bottom of the vessels, is united to the water, and forms elastic vapour; but the vapour thus formed is a conductor of heat; and besides the caloric necessary for its formation, contains also a certain quantity of the same caloric which is capable of affecting the thermometer. The proportion of the two quantities of heat depends upon the nature of the substance in which the water is boiled, and also upon the state of the two surfaces, internal and external, so that the different quality, as well of the substance as of either of the surfaces, may affect the results, but not so as materially to affect the accuracy of the thermometer.

Extract from M. Biot.

"There is also some variation in the boiling point according to the nature of the vessels which we employ, and according to that of the substances which are mixed with the water, even when it cannot dissolve them. For this observation we are indebted to M. Gay-Lussac. In order to verify it by experiment, it is sufficient to put distilled water into a glass vessel, and cause it to boil; it will be perceived to boil by starts and with difficulty. Remove it from the fire, by which we must certainly lower its temperature; and after an interval of some seconds, throw into it a small quantity of iron filings; the fluid will instantly be thrown into a state of complete ebullition. These different operations must, however, necessarily tend to lower its temperature, and consequently the throwing in of the iron filings must have exercised upon it some unknown action which facilitates its ebullition.

"This is the general fact: in order to ascertain its degree, M. Gay-Lussac observed the temperature of the water the moment when it began to boil in a glass vessel; he found it to be 214·2 Fahr. (101·232 cent.) If we throw into the vessel finely powdered glass, the temperature of ebullition descends to 212·6 Fahr. (100·329 cent.); if we put iron filings into it, the temperature descends still lower, and becomes stationary at 212 Fahr. (100 cent.) M. Gay-Lussac also found that the size of the vessel has no influence upon the phenomenon, nor had the greater or less quantity of the iron filings any effect; water heated in a metallic vessel boiled at 212 Fahr. (100 cent.)"—(Biot, Traité de Physique, i. 42.)

ARTICLE XV.

ANALYSES OF BOOKS.

Transactions of the Geological Society, Vols. III. and IV.

(*Continued from Vol.* xi. p. 453.)

III.—2. *On the Oxide of Uranium, the Production of Cornwall, together with a Description and Series of its crystalline Forms.* By Mr. W. Phillips.

In this paper Mr. Phillips describes the varieties of uranite which have lately been found in Cornwall. This mineral had been observed to occur rarely in the mine called Carharack, accompanied with iron ochre, and cubic arseniate of iron. In 1805, Mr. P. discovered uranite at Tincroft mine, near Redruth, accompanied by pulverulent *pecherz,* and at Tol Carn mine, about two miles north of Carharack, also accompanied by pecherz. The most beautiful specimens of this substance, however, have recently been discovered in Gunnislake copper mine, near Callington. The acuteness of Mr. P. has detected a considerable number of new crystalline varieties among his specimens of Cornish uranite, which are described in this paper.

III.—6. *Outlines of the Geology of Cambridgeshire.* By the

Rev. J. Hailstone, F.R.S. F.L.S. Woodwardian Professor in the University of Cambridge.

The upland parts of Cambridgeshire consist of chalk hills, which, at their northern extremity, appear to rest on an extensive bed of blue clay, provincially called *gault*; and on the east, on the borders of Suffolk and Essex, the chalk is covered by a thick deposit of clay. The grey or lower chalk is the most abundant in Cambridgeshire, where it is distinguished by the name of clunch. When burned, it affords a lime in very high esteem, and the harder beds form a good building stone, which, from its standing the fire well, is in great request for the backs of grates and similar purposes. The clunch and subjacent gault appear to pass into each other by insensible degrees; the clunch first becomes sandy, then assumes the appearance of an argillaceous loam, and as it approaches nearer to the gault, becomes mixed with green sand, and contains imbedded nodules of a ferruginous indurated marl. The mass then becomes more uniform in structure, and at length is not to be distinguished from the blue argillaceous marl which forms most of the beds of gault.

III.—7. *Some Observations on a Bed of Trap, occurring in the Colliery of Birch Hill, near Walsall, in Staffordshire.* By Arthur Aikin, Sec. G. S.

The following are the circumstances described in this paper. A vertical dyke of Trap intersects part of the colliery at Birch Hill, and comes up to the surface, forming a long, low mound from 70 to 100 yards broad, and known by the name of the *green rock fault*. A wedge-shaped lateral prolongation of this trap has apparently intruded itself between two of the coal strata, which in those parts of the colliery where the trap does not occur are found in contact with each other. The bed which covers the trap is shale, containing subordinate beds of ironstone, and presents no peculiar appearances, but the three beds which lie below the trap, namely, sandstone, shale, and coal, of the aggregate thickness of about 7½ feet, differ remarkably from the same beds where they are not covered by trap. The sandstone is broken, and angular pieces of the shale are imbedded in it; the structure of the sandstone is more compact; it is harder and of greater specific gravity. The shale is much indurated, has a glossy metallic lustre, and is destitute of bitumen. The coal has a shining, somewhat iridescent lustre, is entirely destitute of bitumen, and when put in the fire, burns rapidly, like common cinder; but where the coal is not covered by the trap, it exhibits the usual characters of common bituminous stone coal.

III.—8. *A Geological Description of Glen Tilt.* By J. M'Culloch, M.D. F.L.S. Pres. G. S. &c.

The interesting appearances in Glen Tilt, first we believe observed by the late Dr. Hutton, have long afforded materials for controversy to Scottish geologists. The observers, to whatever party they have attached themselves, fascinated as it were by the intricate and remarkable phenomena laid bare by the course of the torrent, have for the most part confined their attention to the bed of the stream and its immediate banks: hence has arisen some misrepresentation which a more excursive research would have avoided. The following is an abstract of the observations made by Dr. M'Culloch.

From the junction of the Tarff to the bridge of Tilt, near Blair Athol, a distance of about 10 miles, the glen extends in a direction about N.E. and S.W. The mountains which form the north-western side consist chiefly of granite, generally of a red colour, but in some places passing insensibly into a variety of a grey colour, and containing crystals of hornblende. This latter may, on a superficial view, be mistaken for sienite, but differs from that rock in containing a large proportion of quartz, and but little felspar; it also frequently contains epidote, and numerous, though minute, crystals of sphene. Insulated patches of quartz-rock, schist, and limestone, interstratified with each other, may be seen resting on the granite; which beds, on the south-eastern side of the glen, cover the whole surface to the entire exclusion of the granite. The bed of the torrent, and its immediate banks through the greater part of the space already mentioned, form the line along which the granite emerges from beneath the stratified rocks, and where the following very striking appearances present themselves.

Veins of granite traverse the schist and quartz rock and pass into the accompanying limestone. These veins are occasionally of large size, in which case they may often be clearly traced into the main body of the granite; often, however, they appear to originate and end in the limestone, and present the aspect of detached lumps and irregular processes rather than of veins. Sometimes they intersect and reticulate both the schist and limestone, diminishing to the tenuity of a thread or a leaf of paper. Sometimes thin laminæ of granite may be observed arranged parallel to the beds of limestone, and following every flexure and contortion which it undergoes with the most perfect regularity; sometimes, again, minute points of the same red siliceous matter as constitutes the thin veins of granite occur inhering in the limestone, and from their minuteness are scarcely to be detected, unless where the calcareous base has been worn down by the action of water, in which case, these points are left protruding, and thus give a rough or echinated character to the surface of the limestone. Occasionally the limestone occurs apparently unstratified and in the state of crystalline marble, of a white colour, partially tinged by yellow and pale green. Where the marble is at the greatest distance from the granite, it differs little or nothing in hardness or composition from ordinary specimens of this substance. But wherever it approaches or comes in contact with the granite, it becomes highly indurated, effervesces slowly with acids, and gives on analysis a large proportion of siliceous matter. All the varieties of this marble contain more or less of mica, which excludes it from the statuary's use, though it is perfectly applicable to various architectural and ornamental purposes to which its greyish hue and low tone of colour are more applicable than the dazzling white of the Carrara marble. Steatite and noble serpentine are found mixed with and imbedded in this marble, as also is the case with tremolite, which latter mineral besides constitutes thin beds alternating with the marble. Beds of sahlite, affording several varieties of this substance, are likewise associated with the limestone.

From the above and other similar appearances, Dr. M. concludes the general structure of this part of the country to be composed of regular, even, and defined alternations of quartz rock, schist, and limestone, resting on granite, the immediate covering of the granite being sometimes one, sometimes another of the superincumbent stratified beds. In every instance where the granite is actually visible in contact with the neighbouring rocks, great confusion and disturbance are apparent, consisting in a general mixture of all the stratified rocks with the granite, and a total discomposure of their regularity, being at the same time accompanied by the passage of minute veins from the mass of granite into the stratified rocks. Where on the contrary the beds lie out of the immediate vicinity of the granite, they retain their parallelism and regularity, its influence appearing to extend to a very short distance beyond the point of actual contact.

III.—9. *Sketch of the Geology of the south-western Part of Somersetshire.* By L. Horner, Esq. F.R.S.

The high part of the district here described, including the Quantock hills, is elevated from 800 to 1,600 feet above the level of the sea, and is occupied, generally speaking, by a greywacke formation, consisting of sandstones, more or less clayey and fissile, of schist, coarse or fine slaty, and often inclosing thick irregular beds of limestone, abounding for the most part in madrepores. Curvatures, contortions, and fractures, are of frequent occurrence in the various beds of this formation, indicating it to have been subjected to the violent impulse of some unknown agent, while the beds still preserved a greater or less degree of plasticity.

The rock on which this greywacke rests is unknown; in a single instance Mr. H. discovered a vein of granite traversing the slate, and as usual producing a degree of induration on those parts of the rock which are actually or nearly in contact with it.

The greywacke is bounded in every direction by that deposit, called by the name of red rock, red marl, red ground, &c. which consists of beds of conglomerate, of red sandstone, and of a red and greenish grey indurated marl, in which rock salt and brine springs are usually found.

On the north of the red sandstone, and occupying the principal part of the coast from Minehead to the mouth of the Parret, occur beds of lias limestone. The junction of the red sandstone and lias is very apparent on many parts of the coast; but such is the disturbance and mutual intermixture of these rocks, that it is by no means easy to obtain a satisfactory proof of their relative superposition with regard to each other. The upper beds of the lias are of a light blue colour, which, by calcination, or long exposure to the atmosphere, passes to a yellowish buff colour: the lime which they produce is not in much estimation for agricultural purposes, but has the valuable property of forming a cement, which sets under water. The limestone of the lower beds of the lias is of a much darker colour, is very fetid when rubbed or struck, and yields a lime in great estimation as a manure.

The lamellar blue clay, which alternates with the beds of lias, incloses lenticular concretions of clayey limestone, many of which when broken present the structure of septaria, the sparry matter of the veins being in some instances calcareous spar, in others sulphate of strontian, occasionally in well defined crystals.

The red sandstone on the coast west of Watchett contains much gypsum, inclosing grains of sand and small pieces of quartz; but no rock salt has hitherto been observed in it.

Three miles west of the mouth of the Parret the coast consists of deep and almost fluid mud, containing many trunks and branches of trees, of which some of the former still retain their natural position. Much of the timber has of late years been carried off by the neighbouring inhabitants for fuel and other purposes. How far this submarine forest extends to sea is unknown.

III.—10. *Description of a Clinometer.* By the Right Hon. Lord Webb Seymour, F.R.S. &c.

The description of this instrument for measuring the inclination of strata cannot be understood without the accompanying plates.

(To be continued.)

ARTICLE XVI.

Proceedings of Philosophical Societies.

GEOLOGICAL SOCIETY.

May 15.—The reading of a paper, by Thomas Weaver, Esq. "On the Geological Relations of the East of Ireland," was commenced.

June 5.—The reading of Mr. Weaver's paper was continued.

June 19.—The reading of Mr. Weaver's paper was concluded.

The district described in this paper is bounded on the E. by the Irish channel, and on the S. and W. by the mountains which confine the Suire and Shannon, and on the N. by the hills of South Meath, Cavan, and Longford, and by a line produced from thence to the bay of Galway. It is about 100 Irish miles from N. to S. and 60 to 90 from E. to W. comprehending about ¼ part of the island. It may be divided into primary tracts, comprehending

Granite,
Mica slate,
Clay slate,
Transition tracts,
Floetz tracts, and
Alluvial tracts.

The granite principally occupies an extended line passing through the counties of Wicklow and Carlow, and is succeeded in the northern portion by mica slate, resting on its eastern and western sides; but towards its southern extremity, the mica slate is wanting; and it is found in contact on the eastern side with clay slate, and on the western with the floetz limestone. The clay slate is found also occupying a large part of the county of Waterford, and occurs again to the westward, in the counties of Clare and Tipperary.

These primary rocks are found variously stratified with each other, and with trap, porphyry, and greywacke, both compact and slaty.

The portion to which the author has assigned the application of transition tract, is of very limited extent, and occupies the northern part of the county of Dublin, and the western part of Meath. It consists of clay slate conglomerate, greywacke, and greywacke slate, interstratified with limestone, trap, and porphyry.

The floetz tract is much more considerable, and may be divided into

The old sandstone,
The floetz limestone, and
The coal district.

The old sandstone is much dispersed, and is found resting on granite, clayslate, and greywacke, and occurs sometimes in isolated portions, and sometimes forming mountain masses.

The floetz limestone is the most extensive formation in Ireland. With the exception of the counties of Derry, Antrim, and Wicklow, there is no part of the island in which it does not more or less prevail. It exhibits considerable variety of character in colour, structure, and hardness, and is found both in unmixed and continuous strata, as well as associated with other rocks, and sweeps round every mountain tract, filling up all the intervening spaces.

The coal district of Leinster forms a range of low hills, placed upon and elevated above the floetz limestone. It is about six miles broad and about 18 in length, and consists of coal alternating with shale and great stones, and resting on a bed of fine clay.

The alluvial tract contains with the limestone gravel, some valuable and extensive beds of marl, containing the remains of the Irish elk, and, in one instance, of the red deer. But the bones of a complete skeleton of the elk have not yet been found together.

At the same meeting, a paper, by H. Warburton, Esq. was read, "On Chromate of Iron as a volcanic Production."

In the Journal de Physique for March, 1818, the Chevalier Sementini describes some red earth, which fell in Calabria, mixed with crystals of pyroxene, and found on analysis to contain chrome, which M. Sementini considers indicative of meteoric origin.* Mr. Warburton observes that pyroxene is almost exclusively of volcanic origin, and he refers to a specimen of olivine presented by him last November to the Society, from the extinct volcanoes near Geroldstein, coloured green by oxide of chrome, and accompanied by grains of chromate of iron. From these circumstances, Mr. Warburton infers the greater probability that the earth in question was of volcanic origin.

ROYAL ACADEMY OF SCIENCES AT PARIS.

March 2.—M. Vallée presented in manuscript a treatise on descriptive geometry accompanied by drawings.

The committee appointed by the academy to adjudge the prize offered in the class of physics to the best essay on the thermometric scale and the laws of the transmission of heat, made their report. The memoir which, in the unanimous opinion of the committee, was worthy of the prize, proved, on opening the accompanying sealed note, to be the joint production of M. Petit, Professor at the Ecole Polytechnique, and of M. Dulong, Professor at the Ecole Royale of Alfort.

M. Geoffroy-Saint-Hilaire read a memoir on the Os Hyoides of the Mammalia.

M. Manouri-Dectot read a memoir on a new Steam Engine, and M. Delille read one on the *Persea*.

March 9.—M. Geoffroy-Saint-Hilaire presented a printed copy of a memoir, "On the Unity of Composition and Identity of the Substances composing the respiratory Organs in Animals with Vertebræ."

M. F. H. du Locle communicated a memoir on the Isochronism of Spiral Springs.

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* See *Annals of Philosophy*, xi. 466.

M. Chaptal, in the name of the committee to whom the subject was referred, gave an account of the memoirs that had been received in claim of the prize offered by the late M. Ravrio for the best method of protecting gilders from the fumes of the mercury employed in their art. The prize was adjudged to M. Darcet, *Verificateur Géneral* of the Mint.

M. Legendre anounced that the papers sent in claim of the prize for the *Theorem of Fermat* are not possessed of sufficient merit.

M. Humboldt read a memoir on the *Arbre de la Vache* (Cow Tree).

M. Gillet-de-Laumont announced the discovery of a new alkali in the petalite of the mine of Uto in Sweden.

The reading of a memoir by M. Beudant, on the Varieties of Form in Crystals of the same Species, was begun.

The Academy adjudged the annual prize founded by M. de Lalande to Mr. Pond, Astronomer Royal at Greenwich, for his investigations on the annual parallax of the stars.

March 16.—M. Delambre read the eloges of MM. Rochon and Messier, and M. Cuvier read those of Werner and of Desmaretz.

M. Girard read a memoir, entitled "An Historical View of Inland Navigation."

March 23.—A letter of M. Berzelius addressed to M. Berthollet was read, announcing the discovery of two new substances. M. Vauquelin read a note on the same subject.

The Marshal Duke of Ragusa made a report on a work by M. Dupin, entitled "An Essay on the Progress of Artillery, and of Military Engineering in Great Britain."

M. Dupin has examined with attention, and given a description of the principal military establishments in England, viz. Woolwich, Portsmouth, Chatham, &c.

The great laboratory and military manufactory of the state, is at Woolwich, in which arsenal are more than 10,000 cannon, besides a vast number of mortars, and other species of artillery. Portsmouth and Chatham are fortified, but offer nothing in this respect worthy of remark.

The steam engine and the hydraulic press are at present the principal moving powers employed in England; and it is not without surprise that we see engines performing the work of 200 or 300 horses without confusion and without noise. The hydraulic press of Pascal, brought to perfection by Bramah, was found during the late war to be eminently serviceable in reducing the bulk of hay, and of stores and equipments of various kinds.

The application of rockets to military purposes is not considered by M. Dupin as of much importance; but the effect of the Shrapnel shells is acknowledged by him to be most formidable.

The reading of M. Beudant's memoir was continued.

March 30.—M. de Varennes delivered in a description of a species of incombustible cloth, which was referred to a committee.

M. Desfontaines made a report on M. Dellile's memoir on the Persea.

The persea was a tree formerly cultivated in Egypt for the sake of its fruit, and of which Theophrastus, Dioscorides, Pliny, and other ancient naturalists have made mention. The former of these writers thus describes it. "There grows in Egypt a remarkable tree called persea. In its leaves, flowers, and manner of growth, it resembles the pear tree; but differs from it in being evergreen. It produces fruit in abundance, which ripens about the time of the Etesian winds. When the fruit is intended to be kept, it is gathered before it is quite ripe. In this state it is of a greenish colour, and in form like an almond or elongated pear: the pulp, which is soft, agreeable to the taste, and of easy digestion, incloses a stone like that of a plum, but smaller and harder. The wood of the persea is dense, and of a fine black colour, and is used for making tables and statues." Many modern naturalists have sought for this tree, but without success. M. de Sacy, in his translation of the Description of Egypt, by Abdallatif, an Arabian physician, proves that the tree described by the ancient writers of that nation under the name of *lebakh,* is the persea of Theophrastus. This tree has for some ages past disappeared from lower Egypt; but M. Dellile thinks that he has recognized it in the Xymenia Egyptiaca of Linnæus, of which he saw one specimen in a garden at Cairo, and two others in Upper Egypt. It is, however, common in Nubia and Abyssinia, where it is known by the name of *glig.* The committee think the opinion of M. Dellile to be in all probability well founded, and propose that his memoir should be inserted among the Scavans étrangers.

M. Poisson read a memoir on the Motion of Elastic Fluids.

The reading of M. Beudant's memoir was concluded, and was referred to a committee.

M. Fresnel read a memoir on the Colours produced in homogeneous Fluids by polarized Light.

M. Moreau de Jonnès read a memoir on the Coluber Cursor of Martinique.

April 6.—M. Dupin presented in manuscript that part of his *Voyage en Angleterre* relating to the construction of ships; it was referred to a committee.

M. de Lavalette gave in a supplementary letter on the musical notation of the Greeks; this also was referred to a committee.

M. Biot presented a specimen of the glass employed by Mr. Stevenson in the Bell-rock light-house in Scotland. It is a red glass, the colour of which is occasioned by a thin, superficial coating of metallic oxide. The cost is considerable; and the reporter *suggests that hollow* glasses of any desired form, and filled with coloured fluids, like those which ornament the shop windows of druggists, would, in all probability, answer the end at a much less expense.

M. Gillet de Laumont stated that lithion occurs much more abundantly in the triphane than in the petalite.

M. Beauvois read a description of an aggregation of stones observed in the United States, and known by the name of the natural wall.

M. Geoffray-Saint-Hilaire continued the reading of his memoir on the Pulmonary Organs.

M. Constantio, a Portuguese physician, read a memoir, in which he attributes a very marvellous effect to a certain balsam invented by M. Malati, a Spanish physician; which was referred to a committee.

April 13.—M. Moreau de Jonnès read a memoir on the Calcareous Islands of the West Indies.

A series of observations by M. Dupetit-Thouars on the Effect of Frost on Vegetables, was referred to a joint committee of botany and agriculture.

M. Girard read a report on a machine invented by MM. Lacroix and Peulvay, a model of which was presented to the Academy.

April 20.—A sealed packet containing theoretical views on certain phenomena of light, by M. Fresnel, was deposited with the Academy.

M. Rebours presented a new instrument, called by him *micro-telescope;* which was referred to a committee.

M. Pelletier read a memoir on Cochineal. A bed for the use of women in labour invented by M. Rouget was referred to a committee of Surgeons.

The continuation of "Meteorological Observations made at Alais, during the year 1817, by M. Hombres-Firmas," was read.

April 27.—M. Rauzon de Passan sent a new letter on the Theorem of Archimedes respecting the ratio of the cylinder and the inscribed sphere; referred to a committee.

M. Painsot read a memoir on the theory of numbers, entitled "An Analytical Representation of the Remainders of Powers, by the Formula of imaginary Roots of Unity."

M. Julien-le-Roi presented the description of a carriage invented by him; referred to a committee.

M. Richerand read a memoir on a successful operation, in which portions of three ribs were removed, and the pleura was wounded.

M. Dellile's memoir on the Date Palm, cultivated in Egypt, was referred to a committee.

M. Colin presented an instrument of his invention for the purpose of facilitating the circular incision recommended for curing the bleeding of the vine.

A memoir was read, by M. France, on the Shells composing the *Genus Cabochon.*

ARTICLE XVII.

SCIENTIFIC INTELLIGENCE, AND NOTICES OF SUBJECTS CONNECTED WITH SCIENCE.

I. *Effect of Camphor on heated platina Wire.*

The method of keeping a platina wire incandescent by means of the vapour of alcohol has been fully described in a former number of this journal. Sir H. Davy has discovered that the vapour of camphor will produce a similar effect. For this purpose lay a piece of camphor, or a few fragments on any convenient support, and place upon it a coil of platina wire made red hot; the wire will immediately begin to glow, and will continue in that state as long as any of the camphor remains.

II. *Silver from Luna Cornea.*

The following method of obtaining metallic silver from luna cornea has been discovered by M. Arfvedson:

Put some grains of zinc into a conical glass, and cover them with luna cornea; then pour in carefully some diluted sulphuric acid. The hydrogen gas thus liberated will soon reduce the silver to the metallic state.

III. *Geological Situation of the Gems of Ceylon.*

From a letter of Dr. J. Davy's, inserted in the last number of the Royal Institution Journal, it appears that gems abound in the district of Matura, situated in the south of the island of Ceylon. They are procured by the natives from alluvial soil; but the native repository of the sapphire, the ruby, the cat's eye, the different varieties of zircon, and cinnamon stone, has been ascertained by Dr. D. to be gneiss.

IV. *Geological Description of Adam's Peak in the Island of Ceylon.* By Dr. Davy.*

"Geologically considered, the mountain may be said to be composed of gneiss. The rock on the top, on which is the impression of the foot, is gneiss of a very fine grain. It abounds in quartz. It is hard and compact, of a grey colour, and only in mass exhibits a flaky structure. A little below, felspar predominates, and the rock is rich in garnets. Here it is in a soft state; and towards the surface rapidly decomposing. Still lower, hornblende prevails, and in so large a proportion that particular masses may be called hornblende rock. Near the bottom, felspar again predominates, and the rock contains much molybdena disseminated through it. Besides, in different places the rock exhibits other peculiarities; here abounding in quartz, in a massive form; there in mica, in large plates, and very frequently rich in iron and cinnamon-stone. Garnet, traces of the ruby, and adularia, were the only minerals which I observed; but I have no doubt more minute examination would have detected others, and particularly the corundum, all the varieties of which, including the finest blue sapphires, are found in considerable abundance in the alluvial country at the foot of the mountains."

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* Extracted from an account of Adam's Peak in the Journ. of Science and the Arts, v. 25.

Dr. Davy remarks that the height of Adam's Peak has been much exaggerated, and that the estimate of 15·000 feet is evidently incorrect. From his barometrical observations, he is disposed to think that it does not exceed 6343 feet above the level of the sea; but as the author himself acknowledges, this conclusion cannot be regarded as more than an approximation to the truth, as there was no barometer at the bottom of the mountain to compare with the one at the top. This deficiency is, however, less important in the tropical regions, where the weight and temperature of the atmosphere are so nearly stationary.

V. *On the Acidity of Tungsten and Uranium when saturated with Oxygen.* By M. Chevreul.*

When the tungstate of ammonia is calcined, a yellow powder remains, which is tungsten saturated with oxygen. Many chemists having observed that this powder had no action upon litmus, have concluded that tungsten saturated with oxygen was not properly entitled to the appellation of an acid. M. Chevreul wishing to assure himself of the fact, whether tungsten saturated with oxygen, which had no sensible affinity for acids, but which, on the contrary, had a very decided one for alkalies, did not redden litmus, heated tunstate of ammonia with litmus, when he observed that the ammonia was disengaged, and that the litmus was reddened; hence he concludes that what has been called tungstic acid possesses a real acidity. M. Chevreul, when he communicated this observation to the Philomathic Society, stated that since he had performed the experiment, he found a similar remark in the memoir of the D'Elhuyarts.

The peroxide of uranium is known to have the property of being dissolved in the sub-carbonate of potash, but it is not generally known that the native peroxide of uranium, and that which is formed from the nitrate, after having been decomposed by heat, causes litmus to assume the red colour; likewise that the peroxide of uranium heated with a solution of the subcarbonate of potash, is dissolved in it without disengaging any carbonic acid; and that the solution, which has a beautiful lemon yellow colour, when sufficiently concentrated, affords crystals of the same colour.

M. Chevreul has observed that the peroxide of uranium causes hematine to assume the blue colour, a circumstance which connects it with the salifiable bases.

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* Bulletin des Sciences for 1818, p. 20.

VI. *Method of making Salt in the Great Loo-choo Island.*[*]

Near the sea, large level fields are rolled or beat so as to have a hard surface. Over this is strewn a sort of sandy black earth, forming a coat about a quarter of an inch thick. Rakes and other implements are used to make it of a uniform thickness, but it is not pressed down. During the heat of the day, men are employed to bring water in tubs from the sea, which is sprinkled over these fields by means of a short scoop. The heat of the sun, in a short time, evaporates the water, and the salt is left in the sand, which is scraped up and put into raised reservoirs of masonry about six feet by four, and five deep. When the receiver is full of the sand, sea water is poured on the top; and this, in its way down, carries with it the salt left by the evaporation. When it runs out below at a small hole, it is a very strong brine; this is reduced to salt by being boiled in vessels about three feet wide and one deep. The cakes resulting from this operation are an inch and a half in thickness.

The above account will be considered interesting, both as exhibiting the degree of perfection to which the arts of life have been carried in that remote and insulated country, and as being essentially the very same process which is practised on the western coast of France, particularly in Lower Normandy, and at the isles of Oleron and Rhé.—(See Journ. des Mines, No. 7, p. 61; Encyc. Meth., Arts and Metiers. Article *Salines.*—Ed.

VII. *On Street Illumination.* By John Millington, Esq.[†]

After remarking upon the very imperfect state of the old oil lamps that are employed in the streets of London, and the important improvement made upon them, first by Lord Cochrane's lamp, in which the combustion is promoted by a current of air entering at the bottom of the glass, and still more by the use of coal gas, Mr. Millington proposes an alteration in the reflectors that are employed. As the author properly observes, the object is not to produce a concentration of light, but an equable diffusion of it, exactly the reverse of the effect which is produced by the lenses which still dazzle the eyes in some parts of the metropolis. The reflectors employed by Lord Cochrane, although the best that have been employed so far as their form is concerned, are defective from the material of which they are composed. This is tinned iron, which although it is at first sufficiently brilliant, yet it soon loses its brightness by the smoke which adheres to it, or by the friction necessary for keeping it clean. As a substitute for the tin, Mr. Millington proposes to employ glazed white earthen ware; it has a strong reflecting surface; is very easily kept clean, is not expensive, and might, he conceives, be so fixed, as not to be liable to be broken. For the purpose of disposing of the light in the most useful manner, the lower surface of the reflector, which is placed over the lamp, should either be flat or curved outwards, so as to disperse the rays, unless the object be to concentrate the light in any particular spot, when a concave dish, forming a portion of a hollow dish, may be used.

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[*] Extracted from Capt. Hall's "Account of a Voyage of Discovery to the West Coast of Corea, and the great Loo-choo Island."

[†] Abridged from the Journal of Science and the Arts, v. 17.

VIII. *On the Colour of Bodies.* By M. Prevost.

A new hypothesis respecting the cause of colour in bodies has been lately proposed by M. Ben. Prevost, according to which it is supposed that the effect depends not upon reflection but upon radiation. It was formerly supposed that the different rays which compose white light, were all of them, except those which produce the colour of the body, absorbed by it, whilst these were reflected; M. Prevost, however, conceives that coloured bodies reflect a portion of the light in its white or compound state, and that they decompose a part of that which penetrates their substance into two new parts, one of which remains in the body, and the other radiates from all parts of their surface. The colour of bodies, as we commonly see it, is rendered pale by the white light which is mixed with it; but it may be deprived of this by a series of mutual reflections and decompositions, so as considerably to augment the intensity of the colour. If, for example, we receive successively the image of a plate of gold which is polished and illuminated by a bright light, upon a second plate, and this image upon a third, &c. we may, after 12 or 18 of these successive reflections, procure a deep red orange, which is probably the real colour of gold. By applying the same process to copper, we procure a colour which approaches to that of scarlet; silver becomes of a beautiful yellow; tinned iron exhibits a yellow deeper than that which is generally ascribed to gold; and in short M. Prevost concludes from his experiments that there is no metal which is properly white or grey; but that they all of them possess some decided brilliant colour.

IX. *M. Depretz' Experiments on the Cooling of Metals.*

A series of experiments have been performed by M. Depretz on the cooling of metals, which appear to have been conducted with considerable attention to accuracy. His object was to examine their specific heat and their conducting power, which points, although they had been made the subject of experiment, he conceived had not been ascertained with correctness, because the experimentalists had not been aware of the effects of radiation from polished surfaces. He employed balls of metal, with a cavity in the center adapted to a thermometer; filings of the metals were placed round the bulb so as to fill up the cavity, and the apparatus was heated by a current of hot air. Of the results of his experiments, we hope to give an account in a future number of the *Annals*.

X. *M. Horner's Photometer.*[*]

M. Horner, of Zurich, has proposed a new instrument for measuring the intensity of light, which is very cheap and simple, and has been found upon trial, as it is said, to afford very satisfactory results. It consists of a tube four inches long and an inch and a half in diameter, made of pasteboard, and there is a contrivance at one end by which bodies may be placed across it in a regular and uniform position. The bodies that are employed by M. Horner are discs of very thin varnished paper, and according to the number of these that it is necessary to employ in order to intercept the light that we are examining, we estimate its intensity.

XI. *On Phosphate of Iron* By J. Murray, Esq.

(To the Editors of the *Annals of Philosophy.*)

GENTLEMEN, *Ayr, May* 19, 1818.

In reference to the notice of "Native Prussian Blue" (blue iron ore, or earthy phosphate of iron), in the *Annals of Philosophy* for May, I may mention that during my visits to the Isle of Man last year, I paid some attention to its interesting mineralogy.

On the farm of Ballatesin, in the parish of Ballaugh, there is a bed of white shell marl running N.E. by E., and S.W. by W. This marl is white as chalk when dry, and so light as to be supernatant. Peat, or bog earth rests incumbent on the marl. The marl is hollow on the surface, and seems to form an independent basin, the extent of which is not yet ascertained.

About five yards below the surface, various elk horns (the fossil elk of Ireland) have been found. Those first discovered were attached to the bones of the skull, and measured 11 feet from tip to tip. The horns since observed are much fractured. Different other bones of the skeleton are occasionally met with. These all lay in a horizontal position. On minutely examining the interior of a fragment of one of these horns, I found a considerable portion of the blue earth in question; and on further search, quantities interspersed through the caked peat earth incumbent on the marl. The recent fracture is uniformly blue, feels meagre to the touch, and soils the fingers. It is found in small lumps, earthy, and in powder. The colour much resembling common powder blue, or prussian blue of an inferior description.

I have not yet analyzed this interesting substance, to determine whether the analysis which considers it to be a compound of iron and phosphoric acid be correct; but whether it be so constituted, or possesses for its proximate parts red oxide of iron and prussic (hydrocyanic) acid. Its production is easily accounted for. The peat earth is highly impregnated with red oxide (peroxide) of iron; this filtering through the superstrata comes in contact with the osseous phosphate of lime, and the phosphate of iron is formed. On the other hand, the prussic acid may be easily supposed a resulting product of the decomposing horn. Carbonate of ammonia, being thus freed, contains the elemental constituents of prussic acid, and a slight modification in the ratio of the proportional quantities would give form to the hydrocyanic acid, one of the constituents of prussian blue, the prussiate of iron.

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[*] Abridged from Bibliotheque Universelle, vi. 162.

In this valuable marl are found chips of flints.

I have the honour to be, Gentlemen,
Your most humble servant,
J. MURRAY.

XII. *Analysis of the Eggs of the Pike.* By M. Vauquelin.*

A portion of these eggs was washed in a large quantity of water; the water was evaporated, and a white coagulable substance was procured, which was completely soluble in caustic potash, and was precipitated by the infusion of galls and nitric acid. By drying and calcining this substance, its saline contents were separated and their nature ascertained; the coagulable substance was determined to be albumen, and the salts were found to be potash, phosphate of potash, muriate of soda, and phosphate of lime. The water which had been separated from the coagulum was next examined, and was found to contain both animal and saline matter; a great number of reagents were employed to ascertain the nature of each; and the result of the experiments was, that there were two kinds of animal matter, one of an oily nature, and the other "an animal substance having a relation to gelatine." This it may be presumed was the same kind of substance which Dr. Bostock found in the albumen ovi of the common fowl, and which has since been found in all albuminous fluid. The salts in what may be termed the serosity of the egg were the muriates of potash, soda, and ammonia, the phosphates of potash, lime, and magnesia, and the sulphate of potash. The eggs, likewise, were found to contain phosphorus. The author observes that there is a very strong resemblance between the eggs of fish and those of birds in their composition. There is, however, one circumstance in which the eggs of the pike differ from birds' eggs, that the oil which in the latter is mild, and of an agreeable odour and flavour, in the former is acrid and extremely nauseous, so as to produce vomiting when taken into the stomach. M. Vauquelin observed the same circumstance with respect to the eggs of the pike that

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* *Abstracted from Journ. Pharm.* iii. 385. (Sept. 1817.)

Fourcroy and he had noticed in their experiments upon the mil. of the carp, that a large quantity of phosphoric acid was produced by combustion. It is upon the whole more probable that this phosphoric acid was generated by the union of oxygen with a portion of the phosphorus which was contained in the substance of the eggs, than that it was produced merely by the decomposition of any phosphoric salts.

XIII. *Notice of the Chevalier Giescke's Travels in Greenland.*[*]

M. Giescke spent five winters in Greenland, the first at Godt-Laub (Good Hope) in the latitude of 65°; the three next in the island of Disko, in the latitude of 70°; and the last at Omenak, at 73°. The most severe cold which he experienced was about — 39° Fahrenheit, that at which mercury freezes, and the greatest heat about 86° Fahrenheit. The whole country is traversed by an immense mass of ice, divided by deep fissures, that completely cuts off all communication from one part to the other; the thickness of the ice is in many parts more than 100 fathoms. The trees consist merely of a few small and stunted specimens of the dwarf birch and some species of willows; the only plants that are employed for food are the Rhodiola rosea, the roots of the Polygonum viviparum, the flowers and leaves of the Saxifraga oppositifolia, the Oxalis, the Angelica, and the Cochlearia; there are also the berries of the Empetrum nigrum, and the Vaccinium, which are the only fruits that are found in Greenland.

The Greenlanders seem to belong to the Mongol race; their stature is small, and they seldom arrive at a greater age than 50 years; the women are nearly as tall and as robust as the men, and join with them in all their labours and exercises. Their habitations are all situated near the coast, as the climate is there less severe, and it is more convenient for fishing, which is their principal occupation; they are generally placed in the recesses of the rocks, and are supported by them; they are constructed of large masses of micaceous schistus, the crevices of which are filled with peat, and are lined with moss. Each hut is about 15 feet square, and is occupied by about 20 individuals, who lie in it promiscuously. The apertures for the purpose of admitting light are closed with the intestines of the seal instead of glass; and the entrance into the huts is a long and narrow passage which just admits a man to creep in. They are heated and lighted by a lamp, which is suspended in the middle of the chamber, and over this they cook the flesh of the seal, which in the winter is their principal food. The houses are almost totally without any description of furniture, and are filthy to a degree which can scarcely be conceived; all access of fresh air is carefully excluded, and the heat and stench is absolutely insupportable, except to those who have been inured to them from infancy. Their only domestic animals are dogs, which serve as beasts of burden, and are employed by them in place of horses.

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[*] Abridged from Bibliotheque Universelle, vii. 133. (Feb. 1818.)

The sea-coast is almost covered with rocks and shoals, and is without any appearance of vegetation; the part which is not composed of rock being either bog or marsh. The rocks are, however, covered with very beautiful lichens and mosses of the most brilliant colours; and the cascades which fall from the glaciers between the rocks occasionally form very grand scenes

M. Gieske has paid the most minute attention to the mineralogy and natural history of Greenland; he has particularly noticed many remarkable geognostic facts, and has also discovered several new mineral substances. He is at present preparing to publish an account of his travels both in English and German; the work it is said will extend to three large volumes, and will contain many engravings consisting of views of the country, and representations of the inhabitants, their utensils, costume, &c.

XIV. *Experiments to determine the Action of Alcohol of different Degrees of Strength on the Oil of Bergamot.* By M. Vauquelin.*

It is a common practice with the dealers in perfumes to adulterate the oil of bergamot with alcohol; and M. Vauquelin was induced to make a series of experiments in order to discover the effects that were produced by the mixture of these two substances, and thus be enabled to detect the fraud. He found that 100 measures of alcohol dissolved 50 measures of oil, but that there were several anomalies in the proportions in which smaller quantities of alcohol dissolved the oil. The general results of the experiments are; 1. That the oil of bergamot may contain eight per cent. of alcohol, of the specific gravity of ·817, without its being perceptible when mixed with water. 2. That when it contains a greater quantity of it, the surplus separates, dissolving about $\frac{1}{3}$ of its volume of oil. 3. That a small quantity of water mixed with the alcohol diminishes remarkably its action upon the oil; since alcohol of specific gravity ·880 dissolves only $\frac{1}{28}$ of its volume, while pure alcohol dissolves almost $\frac{1}{2}$ its volume. 4. That when we mix alcohol with a volatile oil, a mutual exchange takes place between the two fluids, the relation of which must vary with the purity of the alcohol; this last dissolves the oil, whilst the oil absorbs the alcohol. 5. That when we mix alcohol of specific gravity ·847, for example, with oil of bergamot, which is ·856, the alcohol sinks to the bottom, and the oil swims upon it; this depends upon the oil absorbing a part of the pure alcohol, and thus rendering the remainder more dense, while it becomes itself more light. 6. That there takes place a kind of decomposition of the water and alcohol by the oil; from which it may be suspected, that if we were to mix a small quantity of diluted alcohol with a large quantity of volatile oil, the water would be separated, and be precipitated alone to the lower part of the vessel. Hence we learn that the dealers in perfumes may introduce eight per cent. of alcohol into them without our being able to detect the fraud by the ordinary means; but it may be discovered by the assistance of the spirit hydrometer, as the density will be diminished by about $\frac{1}{100}$ part.

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* *Abridged from* Journ. Pharm. iii. 241. (June, 1817.)

Sulphuric ether does not act on the oil of bergamot like alcohol; it unites with it in all proportions, and the fluids do not afterwards separate.

XV. *Analysis of Rice.* By M. Vauquelin.*

The object of the author in this analysis was chiefly to ascertain in what respect rice differs from the other cerealea; and especially to know whether it contains any saccharine matter proper for the formation of alcohol. A quantity of rice was pounded and macerated during some time in water; a transparent mucilaginous liquor was formed, without taste, that was neither acid nor alkaline, and was not precipitated by acetate of lead; by evaporation an extract was formed that in every respect resembled gum arabic. By treating this extract with nitric acid, a strong acid liquor was formed, from which water separated the phosphate of lime. This solution also contains a quantity of starch; and the author found that it was by means of the starch that the phosphate of lime was dissolved in the infusion. He also found in the same manner that animal jelly rendered a portion of phosphate of lime soluble. The author then examined the farina of rice, with a view to discover the quantity of animalized matter which was united to it, by distilling it and ascertaining the amount of ammonia disengaged; this was found to be very inconsiderable; he afterwards made an experiment for the purpose of determining at what degree of heat the starch begins to dissolve in water, which, by means of the test of iodine, he determined to be 144·5°. (F.)

The conclusions which M. Vauquelin deduces from his experiments are, that rice is a grain essentially amylaceous, which contains scarcely perceptible traces of gluten and of phosphate of lime. In this respect it differs from the other cerealea that serve for the nourishment of men and animals, which contain a considerable proportion of these substances. He was not able to detect any saccharine matter in rice, a circumstance which is considered as remarkable, because in some countries an ardent spirit, called arrack, is prepared from it. But potatoes also afford a spirituous liquor, although they, in like manner, contain no saccharine matter; from which we must conclude that alcohol may be formed by something else besides sugar, unless we suppose that the sugar is so enveloped in the other ingredients that it escapes the ordinary means of detection.

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* Abridged from Journ. Phys. Aug. 1817.

XVI. *Analysis of the Kupfernickel.* By Prof. Stromeyer.

Professor Stromeyer has been making an analysis of the kuppernickel of Riegelsdorf, in Hesse, with the following result:

Arsenic	54·726
Nickel, with a slight admixture of cobalt	44·206
Iron	00·337
Lead	00·32
Sulphur	00·401
	100·000

From this it appears that the essential constituents of kupfernickel are arsenic and nickel. This is further confirmed by an analysis, by the same chemist, of the nickel ochre, which, in some cases at least, originates from the spontaneous decomposition of kupfernickel.

Oxide of nickel, with a trace of cobalt	37·35
Arsenious acid	36·97
Water	24·33
Oxide of iron	1·13
Sulphuric acid	0·23
	100·00

Hence the former of these minerals is a native alloy of arsenic and nickel, and the latter is arsenite of nickel.

XVII. *On the new Metal Cadmium.* By M. Gay-Lussac.*

The new metal resembles tin in its colour, its lustre, its softness, its ductility, and the sound which it produces when it is bent. It melts and volatilizes at a temperature a little lower than zinc. It preserves its splendour in the air; but by heat it is changed into an orange yellow oxide, which is not volatile, and which is very easily reduced. This oxide does not colour borax; it dissolves very readily in acids, and forms colourless salts, from which it is precipitated white by alkalies. The hydrosulphuric acid precipitates it yellow, like arsenic. Zinc precipitates it in the metallic state. Its specific gravity at 77° (F.) is 8·635.

The metal was discovered in the autumn of the last year, by M. Stromeyer, while he was officially examining the apothecaries' shops at Hanover. M. Hermann, who prepares this oxide on the great scale for medicinal purposes, having been prohibited from selling it (because the presence of arsenic had been supposed to have been detected in it) particularly examined it, and perceived that it contained a new body, which he procured in a separate state, and sent to M. Stromeyer, begging him to verify his conjectures. M. Stromeyer soon found that it had the same properties with the metal which he had just discovered, to which he gives the name of Cadmium.[*]

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* Ann. de Chim. et de Phys. viii. 100, (May, 1818.)

XVIII. *Experiments on Manna.* By M. Bouillon-la-Grange.[†]

The principal result that M. Bouillon-la-Grange has obtained is that manna consists of two substances, that seem to have distinct properties, and that may be separated from each other. If manna be digested with alcohol, a part of it is dissolved, an amber-coloured fluid is obtained, which, by being partially evaporated and then cooled, deposits crystals in small needles. This part of the manna, which is soluble in cold alcohol, appears to be very analogous to sugar. What remains is a whitish-grey substance, hard, and brittle, upon which cold alcohol has no action; it may, however, be dissolved in boiling alcohol, from which it crystallizes by cooling. This part, when treated with nitric acid, forms the malic and oxalic acids, and a quantity of the mucous acid, which is precipitated.

XIX. *Experiments on Malic Acid.* By MM. Bouillon-la-Grange and Vogel.[‡]

We are informed that a memoir on the subject was presented to the Institute in the year 1807; but it appears that the experiments were considered not sufficiently conclusive, and on this account the authors were induced to reconsider them. We shall not at present detail them to our readers, but we shall state the propositions which they deduce from them.

Nitric acid, however weak, forms with sugar an extractive matter, which unites intimately to the acetic acid, which also results from the action of nitric acid on sugar. This extractive matter combines with lime, barytes, alumine, and many of the metallic oxides, and forms with them compounds, which are nearly or totally insoluble in water. It does not decompose the earthy salts, but it decomposes many of the metallic salts, and especially those with bases of lead and tin. Sometimes it is found perfectly white, at other times more or less coloured, as in the sap of the sycamore, and the birch, and the juice of the houseleek. The juice of apples and of buckthorn contains uncombined acetic acid; and a great quantity of this extractive matter, and the malic acid, which we obtain from these substances, is a compound of acetic acid and this extract. The fluids which do not form a precipitate with the acetate of lead do not contain any of the extract; of this kind are the solutions of sugar and gum, and linseed mucilage. The extract may be separated by barytes, and by combining it with acetic acid, the malic acid may be formed.

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[*] See *Annals of Phil.* xii. 75.

[†] *Abstracted from* Journ. Pharm. iii. 10. (Jan. 1817.)

[‡] *Abstracted from* Journ. Pharm. iii. 49. (Feb. 1817.)

Article XVIII.

Astronomical, Magnetical, and Meteorological Observations.

By Col. Beaufoy, F.R.S.

Bushey Heath, near Stanmore.

Latitude 51° 37′ 42″ North. Longitude west in time 1′ 20·7″.

Astronomical Observations.

June 5.	Immersion of Jupiter's first satellite	14h	7′	17″	Mean Time at Bushey.
		14	8	38	Mean Time at Greenwich.
9.	Immersion of Jupiter's third satellite	13	45	26	Mean Time at Bushey.
		13	46	47	Mean Time at Greenwich.
28.	Immersion of Jupiter's first satellite	14	18	10	Mean Time at Bushey.
		14	19	31	Mean Time at Greenwich.
30.	Emersion of Jupiter's first satellite	11	1	44	Mean Time at Bushey.
		11	3	05	Mean Time at Greenwich.

Magnetical Observations, 1818. — *Variation West.*

Month.	Morning Obſerv.		Noon Observ.		Evening Observ.	
	Hour.	Variation.	Hour.	Variation.	Hour.	Variation.
June 1	8h 25′	24° 35′ 59″	1 25′	24° 44′ 34″	7h 30′	24° 39′ 12″
2	8 35	24 32 46	1 25	24 46 24	7 30	24 36 15
3	8 30	24 33 11	1 35	24 47 38	7 30	24 37 14
4	8 30	24 34 14	1 25	24 47 30	7 30	24 37 19
5	8 30	24 33 04	— —	— — —	7 35	24 37 58
6	8 30	24 32 56	1 10	24 49 22	7 45	24 40 10
7	8 30	24 44 34	1 50	24 53 42	7 25	24 38 45
8	8 15	24 34 01	— —	— — —	7 35	24 38 49
9	8 15	24 33 48	1 25	24 44 37	7 30	24 37 33
10	8 25	24 36 00	1 25	24 45 12	7 25	24 36 50
11	8 35	24 35 02	1 30	24 43 45	7 45	24 39 46
12	8 40	24 34 15	1 30	24 44 00	7 30	24 37 21
13	8 40	24 36 48	1 20	24 41 44	7 40	24 33 20
14	— —	— — —	1 20	24 44 12	7 35	24 37 40
15	8 35	24 35 42	1 30	24 44 45	— —	— — —
16	8 30	24 32 48	1 25	24 44 50	7 30	24 40 06
17	8 35	24 34 56	1 20	24 44 24	— —	— — —
18	8 30	24 34 36	1 25	24 45 26	7 35	24 38 55
19	8 25	24 32 46	1 25	24 47 30	— —	— — —
20	8 20	24 33 42	— —	— — —	7 25	24 36 44
21	8 30	24 32 32	1 40	24 46 11	7 10	24 37 36
22	8 40	24 32 51	1 20	24 43 51	7 40	24 37 57
23	8 25	24 33 14	1 30	24 44 57	7 35	24 37 11
24	8 30	24 33 32	1 35	24 43 22	7 35	24 36 26
25	8 40	24 31 48	1 25	24 46 37	7 30	24 36 56
26	8 30	24 31 57	1 25	24 44 43	7 50	24 39 45
27	8 25	24 31 50	1 30	24 44 30	7 30	24 38 41
28	8 25	24 32 42	1 25	24 44 31	7 25	24 39 05
29	8 30	24 34 53	1 45	24 45 06	7 35	24 35 40
30	8 30	24 34 02	1 15	24 45 18	7 35	24 35 28
Mean for the Month.	8 30	24 33 47	1 27	24 45 11	7 33	24 37 40

In taking the monthly mean of the observations, those on the *morning* and noon of the 7th are rejected, being so much in *excess, for which* there was no apparent cause.

Meteorological Observations.

Month.	Time.	Barom.	Ther.	Hyg.	Wind.	Velocity.	Weather.	Six's.
June		Inches.				Feet.		
1	Morn....	29·550	60°	39°	NW by N		Fine	54°
	Noon....	29·550	68	26	Calm	—	Cloudy	72
	Even	29·560	64	33	Calm		Cloudy	
2	Morn....	29·600	66	38	W		Very fine	58
	Noon....	29·605	73	26	Var.	4·734	Very fine	73½
	Even	29·600	65	30	WSW		Very fine	
3	Morn....	29·654	62	38	W by S		Clear	54
	Noon....	29·657	72	26	SW	—	Clear	75
	Even	29·680	67	33	SSW		Clear	
4	Morn....	29·733	66	36	S		Clear	56
	Noon....	29·750	75	22	Var.	1·935	Wh. haze	76
	Even	29·780	65	29	E		Clear	
5	Morn....	29·876	67	43	ESE		Hazy	55
	Noon....	—	—	—	—	—	—	76
	Even	29·891	67	31	E		Very fine	
6	Morn....	29·900	64	36	NE		Very fine	53½
	Noon....	29·885	75	30	NE	6·957	Very fine	76
	Even	29·885	64	43	Calm		Fine	
7	Morn....	29·825	58	50	NE		Very fine	49½
	Noon....	29·790	73	30	E	7·658	Very fine	75½
	Even	29·795	65	33	NNE		Clear	
8	Morn....	29·825	64	36	NE by E		Clear	55
	Noon....	—	—	21	—	—	Clear	73½
	Even	29·838	66	28	E		Clear	
9	Morn....	29·837	66	35	E		Clear	55
	Noon....	29·820	72	29	E	6·851	Clear	73
	Even	29·786	64	31	E		Clear	
10	Morn....	29·785	66	35	E		Clear	55
	Noon....	29·800	75	25	E	4·812	Clear	76
	Even	29·800	67	34	E by N		Clear	
11	Morn....	29·720	70	34	ESE		Clear	58
	Noon....	29·680	79	24	ESE	6·446	Very fine	80
	Even	29·660	69	35	E		Very fine	
12	Morn....	29·615	71	37	ENE		Very fine	58
	Noon....	29·615	82	23	Var.	4·167	Fine	83
	Even	29·558	71	27	Calm		Cloudy	
13	Morn....	29·510	71	33	WNW		Very fine	62
	Noon....	29·503	82	21	W	3·697	Very fine	84
	Even	29·485	71	30	W		Thunder	
14	Morn....	29·525	—	57	WNW		Rain	61
	Noon....	29·557	70	41	N	—	Fine	71
	Even	29·600	66	40	NNE		Fine	
15	Morn....	29·625	65	47	SSW		Cloudy	54
	Noon....	29·605	72	33	SW	5·278	Fine	74
	Even	—	—	—	—		—	
16	Morn....	29·550	63	47	WSW		Fine	55½
	Noon....	29·507	72	35	WSW	5·908	Cloudy	73
	Even ...	29·435	66	41	SW		Cloudy	
17	Morn....	29·378	64	51	SSW		Showery	60
	Noon....	29·300	76	43	SSW	6·833	Cloudy	70½
	Even	29·275	68	59	SW		Rain	
18	Morn....	29·300	60	42	NNW		Fine	54
	Noon....	29·300	71	32	Calm	—	Cloudy	72
	Even	29·310	63	39	Calm		Cloudy	

Meteorological Observations continued.

Month.	Time.	Barom.	Ther.	Hyg.	Wind.	Velocity.	Weather.	Six's.
June		Inches.				Feet.		
19	Morn....	29·370	59°	39°	WSW		Very fine	53°
	Noon....	29·370	62	35	SW by S	—	Cloudy	65½
	Even	29·236	—	74	SSW		Rain	51
20	Morn....	29·195	56	49	W by S		Fine	
	Noon....	—	—	—	—	—	Showery	63
	Even....	29·365	56	52	WNW		Fine	47
21	Morn....	29·580	57	46	W		Fine	
	Noon....	29·550	63	36	W	—	Sm. rain	65
	Even	29·500	57	57	WSW		Sm. rain	56
22	Morn....	29·340	59	73	SW by S		Showery	
	Noon....	29·285	63	54	W by S	—	Showery	66½
	Even	29·262	59	47	W		Cloudy	49
23	Morn....	29·380	57	43	W		Fine	
	Noon....	29·457	63	33	WNW	—	Fine	66½
	Even ...	29·445	60	35	W		Cloudy	53
24	Morn....	29·487	59	43	NW by W		Very fine	
	Noon....	29·583	66	33	W	—	Fine	69
	Even	29·613	64	34	NW by W		Very fine	55
25	Morn....	29·660	57	56	SW by S		Sm. rain	
	Noon....	29·615	72	38	W	—	Fine	73
	Even	29·583	64	42	W by S		Fine	58
26	Morn....	29·628	64	49	W		Fine	
	Noon....	29·650	71	40	W by S	—	Cloudy	73½
	Even....	29·648	68	43	W by N		Very fine	54½
27	Morn....	29·500	63	50	SE		Very fine	
	Noon....	29·405	78	30	S by W	—	Fine	79
	Even....	29·310	72	36	SW by S		Cloudy	55
28	Morn....	29·336	60	44	W		Showery	
	Noon....	29·393	66	40	W	—	Showery	67
	Even	29·533	62	40	WNW		Cloudy	53
29	Morn....	29·740	62	47	NW		Very fine	
	Noon....	29·782	71	31	W	—	Cloudy	73½
	Even	29·792	68	38	NW		Cloudy	55½
30	Morn....	29·823	65	41	W		Very fine	
	Noon....	29·815	75½	28	Var.	—	Very fine	78
	Even	29·780	69	31	W		Fine	

Rain, by the pluviameter, between noon on the 1st of June and noon the 1st of July, 0·33 inches. The quantity that fell during the same period, on the roof of my observatory, which is flat, covered with lead, and contains 259 superficial feet, 0·336 inches. Evaporation, between noon the 1st of June and noon the 1st of July, 6·98 inches.

ARTICLE XIX.

METEOROLOGICAL TABLE.

1818.	Wind.	BAROMETER.			THERMOMETER.			Hygr. at 9 a. m.	Rain.	
		Max.	Min.	Med.	Max.	Min.	Med.			
5th Mon.										
May 27	N E	30·23	30·13	30·180	67	39	53·0			
28	N E	30·13	30·09	30·110	69	44	56·5			
29	N E	30·13	30·01	30·070	63	41	52·0			
30	N E	30·02	29·90	29·960	65	33	49·0			
31	N W	29·97	29·90	29·935	74	51	62·5			
6th Mon.										
June 1	N W	30·00	29·97	29·985	77	57	67·0			
2	W	30·05	30·00	30·025	80	43	61·5			
3	W	30·14	30·05	30·095	80	45	62·5			●
4	S E	30·30	30·14	30·220	82	45	63·5			
5	E	30·33	30·30	30·315	79	43	61·0			
6	N E	30·33	30·25	30·290	78	45	61·5			
7	S E	30·27	30·18	30·225	77	52	64·5			
8	S E	30·27	30·23	30·250	75	49	62·0			
9	S E	30·23	30·20	30·215	75	46	60·5			
10	S E	30·21	30·10	30·155	80	50	65·0			
11	S E	30·10	29·98	30·040	84	47	65·5			☽
12	E	29·98	29·85	29·915	88	51	69·5			
13	N W	29·93	29·82	29·875	89	58	73·5		3	
14	N W	30·07	29·93	30·000	75	49	62·0		—	
15	S W	30·05	29·92	29·985	78	55	66·5		—	
16	S W	29·92	29·75	29·835	78	59	68·5			
17	S W	29·70	29·67	29·685	74	54	64·0		6	
18	N W	29·79	29·69	29·740	75	49	62·0	50	—	○
19	S W	29·79	29·53	29·660	72	52	62·0	45	2	
20	S W	30·00	29·60	29·800	72	46	59·0	47	1	
21	S W	30·00	29·75	29·875	71	56	63·5	43	6	
22	S W	29·76	29·64	29·700	71	50	60·5	62	25	
23	N W	29·87	29·76	29·820	71	53	62·0	44		
24	N W	30·09	29·77	29·930	74	52	63·0	47	—	
25	S W	30·09	30·02	30·055	79	56	67·5	52		☾
		30·33	29·53	29·998	89	33	62·36	48	0·43	

The observations in each line of the table apply to a period of twenty-four hours, beginning at 9 A. M. on the day indicated in the first column. A dash denotes, that the result is included in the next following observation.

REMARKS.

Sixth Month.—6. Since this period came in, the weather has afforded little variety. The days have been serene, with breezes, which commonly increased with the temperature, and died away at sun-set: the nights nearly calm, with dew, and a peculiarly clear, but not high-coloured twilight. Thunder clouds have shown themselves at intervals in the horizon; and to-day there are large plumose *Cirri*. 8. My brother observed, about nine, p. m. a bright, blue meteor descending from the zenith to the NW. 10. After sun-set, some beautiful diverging shadows on a pure, dilute, carmine tint in the NW. 11. Thunder clouds about. 12. A thunder group in the N and NW: the *Cirrostratus* for a short time assumed the form of the *Cyma*, and several discharges were heard while the *Nimbi* expanded their crowns within view: after this, it lightened in some clouds to the SE. 13. *Cumuli*, mingled with haze and *Cirri*, were followed in London by a smart thunder shower; while at Tottenham there fell but little rain: a lunar corona ensued. 14. A little rain, a. m.: a large, faint lunar halo. 15. A few drops at evening. 16. Cloudy: a strong breeze. 17. A light gale, with a rainy sound, and much cloud; but the showers proved scanty. 18. Much cloud, chiefly *Cumulostratus:* after some light showers, and appearances of rain and thunder to the southward, the twilight cleared up orange. 19, 20. Windy, cloudy: light showers; *Cumulus, Cirrocumulus*. 21. *Cumulus*, with the lighter modification above, increased to obscurity: wind through the day, and small rain, evening. 22. Windy, cloudy morning: this day more decidedly showery. At 11 p. m. a shooting star descended to the SE. 23, 24. More calm, with summer clouds in various modifications. 25. A very slight rain, a. m. followed by fine blue sky, and various clouds carried by a strong breeze.

RESULTS.

Winds in the fore part light and Easterly, in the latter part Westerly and stronger.

Barometer:	Greatest height	30·33 inches.
	Least	29·53
	Mean of the period	29·998
Thermometer:	Greatest height	89°
	Least	33
	Mean of the period (at the Laboratory)	62·36
Mean of the Hygrometer (the latter week)		48
Evaporation (a few days estimated)		4·50 inches.
Rain		0·43 inches.

The clear hot sunshine of the greatest part of this period had the effect of establishing the summer in our climate in a manner to which we have long been unaccustomed. The deeper green of the foliage and the richer colour of many flowers in particular presented a striking contrast to their appearance during the last two seasons; while the soil, parched and cracked over the whole surface of our loamy meadows, bore ample testimony to the continued receptive power of the dry atmosphere. Yet the turf (to use a familiar phrase) did not *burn*, probably in consequence of the supply of moisture still left at a certain depth in the soil,

METEOROLOGICAL TABLE.

1818.	Wind.	Barometer.			Thermometer.			Hygr. at 9 a. m.	Rain.	
		Max.	Min.	Med.	Max.	Min.	Med.			
6th Mo.										
June 26	S W	30·05	29·95	30·000	79	49	64·0	47		
27	S E	29·95	29·67	29·810	84	55	69·5	43	—	
28	S W	30·17	29·75	29·960	72	52	62·0	44	20	
29	Var.	30·26	30·17	30·215	81	51	66·0	43	—	
30	N W	30·26	30·15	30·205	84	52	68·0	43	—	
7th Mo.										
July 1	N E	30·15	30·02	30·085	81	52	66·5	42	—	
2	Var.	30·22	30·10	30·160	73	44	58·5			
3	N W	30·22	30·06	30·140	79	57	68·0	45		●
4	N	30·06	30·04	30·050	77	52	64·5			
5	N E	30·10	30·04	30·070	79	51	65·0	46		
6	S E	30·10	30·00	30·050	84	52	68·0	45		
7	S E	30·00	29·80	29·900	81	56	68·5			
8	N W	30·11	29·80	29·955	74	50	62·0	46		
9	N W	30·11	30·10	30·105	78	53	65·5	45		
10	Var.	30·10	29·95	30·025	76	55	65·5	42		
11	S W	29·95	29·76	29·855	79	50	64·5	42	33	☽
12	N W	29·85	29·76	29·805	74	57	65·5	70	1	
13	N	30·20	29·85	30·025	77	52	64·5	52		
14	N W	30·32	30·20	30·260	83	57	70·0	52		
15	Var.	30·32	30·28	30·300	86	53	69·5	47		
16	N E	30·28	30·18	30·230	88	62	75·0	45		
17	E	30·20	30·09	30·145	82	52	67·0	53	—	○
18	S E	30·09	29·91	30·000	84	57	70·5	50		
19	N W	29·95	29·88	29·915	85	59	72·0	50		
20	Var.	29·95	29·92	29·935	76	52	64·0	55		
21	N W	30·05	29·95	30·000	80	56	68·0	45		
22	S W	30·13	30·05	30·090	84	55	69·5	45		
23	S E	30·13	29·83	29·980	83	60	71·5	47		
24	S E	29·83	29·80	29·815	93	61	77·0	40	9	
		30·32	29·67	30·037	93	44	67·24	47	0·63	

REMARKS.

Sixth Month.—27. It is said to have been misty early. Some remarkable, rapid changes in the electrical state of the clouds took place, the wind being brisk, veering from SE to SW. *Cirri*, passing to *Cirrocumulus* and *Cirrostratus*, grouped like the ribs of a vessel, on a kind of keel presenting downwards; very dense and magnificent. With these were mingled the rudiments of *Nimbi*, one or two of which formed in sight, and probably discharged to the NE of us: a few drops fell, and there were distant thunder storms in different directions at night. 28. Some fine rain, a. m.: several short, heavy showers about noon: inosculation, and gray sky, evening. 29, 30, Fine, with large *Cirri* above *Cumuli*: some drops of rain.

Seventh Month.—A fine display of *Cirrocumulus*, with a specimen of the *Cirrostratus resembling the grain* of wood: also large plumose Cirri, p. m.: Cumulo-

stratus, and a few drops, evening. 2, 3. Exhibitions of the lighter modifications variously interchanging and mingling, succeeded by *Cumulostratus.* 4. Windy morning, and overcast with *Cumulostratus:* a fine day: twilight coloured, with diverging shadows. 5. Very fine day: *Cirrocumulus* above *Cumulus* producing beautiful clouds by inosculation. 6. At *three* this morning, in the NE, a most extensive orange twilight, in the form of a pyramid, resting on a base of low purple haze, occasioned by dew in that quarter. A fine day ensued, with a breeze, and *Cumuli* casting shadows in a somewhat hazy air. 7. The shadows radiating downward from clouds continue, perhaps occasioned by fine dust floating. I observed, in passing Hounslow Heath, two whirlwinds, carrying the dust in a narrow, perpendicular vortex to a great height in the air, from whence it perceptibly showered down again. 8. *Cumulostratus*, after a clear morning: strong breeze and much cloud, with a few drops. 9. Clear morning, with *Cumulus*, *Cirrus*, and a breeze. About seven, p. m., setting out to return from London, I saw, in the NW, a remarkably large *Cirrus*, composed mostly of straight, diverging fibres, extended towards the SW; and which, when I got home, had passed to *Cirrostratus*. In this cloud (as it appears) my family at the same time observed a coloured *solar halo* with two rather indistinct *parhelia*, the whole of which had escaped my notice in coming out of town. They described the *halo* as so large that a considerable portion of the circle, if continued, would have been below the horizon; and the *parhelia* as situated, the one directly above the sun (which was somewhat obscured), the other to the N of it, and both in the circle: the parhelion to the S (if there were one) was behind some houses; and the whole appearance had considerably gone off before they could get to view this side of it. The phenomena were witnessed by several other persons; and the *halo*, I find, was seen likewise at Hertford. 10. A few large drops between six and seven, a. m.: close *Cumulostratus* prevailed afterwards. 11. Large *Cirri*, passing to the form of the *Nimbus*, mingled with *Cirrocumulus* and *Cirrostratus*. In the evening an extensive obscurity in the W and SW, fronted by dense *Cirrostrati:* a fresh, turfy smell came with the wind, and at length, at half-past 10, it began to rain steadily with us. 12. Wet morning: fine day afterwards. 13, 14. Fine, with *Cumuli*, &c. dew, and orange twilight. 15. A *Stratus* last night: thunder-clouds about: the moon bright gold colour, crossed by fine streaks of *Cirrostratus*. 16. The moon paler amidst hazy *Cirrus* and *Cirrostratus*, &c. in SE. 17. Cloudy morning: light shower, then fine with *Cirrus* and *Cirrocumulus*. 18. Thunder clouds, p. m.: *Nimbi*, &c. grouped in the N. 19. Wind, SE; thunder came within hearing to the NW, p.m.: temp. 85°: hygrometer, 30°: not a drop of rain here, and wind NW after it. 20. Thunder groups, and rain visible to northward: fair with us: clouds red at sun-set. 21. Wind W, a. m. *Cirrocumulus*, chiefly in strips from N to S; then *Cumulostratus*, &c. A very variously compounded and coloured sky during twilight. 22. Fleecy *Cumuli*, &c. a. m. 23. Serene, with *Cirrus*, and fine breeze. 24. *Cirrus* and *Cirrocumulus* proceeding to electrical formations: strong breeze and slight solar halo: p. m. after the maximum of temp. was over, *Nimbi*, with thunder and lightning, approached from the south. The clouds at sun-set showed very rich crimson lake and orange tints; and we had showers, with a hollow wind, and lightning, till past midnight.

RESULTS.

Winds light and Variable.

Barometer:	Greatest height	30·32 inches.
	Least	29·67
	Mean of the period	30·037
Thermometer:	Greatest height	93°
	Least	44
	Mean of the period (at the Laboratory)	67·24
Mean of the Hygrometer		47°
Evaporation.		4·60 inches.
Rain		0·63

A period unequalled in warmth since the year 1808, when the seventh month averaged 67·19°, and the thermometer at Plaistow rose to 96°. The eighth month, 1802 (averaging 67·56°), is the only one that has exceeded the present in heat for 20 *years past.*

TOTTENHAM, Seventh Month, 25, 1818. L. HOWARD.

ANNALS

OF

PHILOSOPHY.

SEPTEMBER, 1818.

Article I.

Biographical Notice of M. Deodat de Dolomieu.

Deodat de Dolomieu, of a noble and opulent family, was born at Grenoble on June 24, 1750. Being destined from his childhood to become a member of the military ecclesiastical Order of Malta, he was entered in early youth on board one of their galleys. While in this situation, a quarrel arose between him and one of his young companions, which terminated in a duel of fatal consequence to his adversary. The unfortunate result of this wanton violation of a wise and fundamental law of the Order occasioned the sentence of death to be passed upon him; and it was not till after an imprisonment of nine months that the conditional pardon which he had obtained from the Grand Master was finally confirmed by the Pope. On his liberation he repaired to France, and joined the regiment of Carbineers, in which he had been appointed to a commission some years before. It was at Metz, where the regiment was stationed, that he first became acquainted with the Duke de la Rochefoucault; an intimate and unreserved friendship soon took place between them; and it is probable that the attachment to science, by which this nobleman was distinguished, contributed, in a considerable degree, to direct the energies of the ardent mind of Dolomieu to similar pursuits. By attendance on the lectures of M. Thirion, a physician of Metz, he acquired the rudiments of chemistry and of natural history; and his spirited and successful endeavours in stopping the progress of a fire which threatened the destruction of one of the military hospitals, were rewarded by the notice and personal friendship of M. Thirion.

His earliest publications were translations into Italian of Bergman's Treatise on Volcanic Substances, and of Cronstedt's Mineralogy, to each of which works he added notes. The reputation acquired by these, and by some papers which appeared in the Journal de Physique, aided by the good offices of his friend de Rochefoucault, obtained for him the unexpected honour of corresponding member of the Academy of Sciences. Deeply affected by the distinction conferred by this learned body, he was the more willingly led to regard as a duty that devotion of himself to the service of science which was now become his ruling passion. In pursuance of this resolution, at the age of 26, he resigned his commission in the Carbineers, retaining, however, his connexion with the Order of Malta, in which he rose, in process of time, to the rank of *Commandeur*, and entered on a laborious but interesting course of mineralogical study.

He first established himself in Sicily, for the purpose of examining on the spot the geological connexion of Etna with the non-volcanic part of the island, of investigating the distinctive characters, if such exist, by which the acknowledged products of volcanos may be separated from the class of trap rocks, and of resolving many important inquiries relative to the proximate causes of volcanic eruptions, the degree of heat required to maintain the fluidity of lava, and the materials of which these destructive torrents are composed.

From Sicily he passed into Italy, and examined repeatedly, and with profound attention, not only Vesuvius, but also the numerous extinct volcanos which occupy a considerable portion both of the coast and of the interior of the country between Rome and Naples. These craters, some of which still pour out sulphureous and mephitic exhalations, and hence have formed the scene of many a poetical tale and superstitious legend from the days of the Cumæan Sibyl and of Virgil to the present time, furnished to the philosophical spirit of Dolomieu many rich accessions of fact and of theory. At Naples he commenced an acquaintance with Sir W. Hamilton, the British Embassador, which similarity of pursuits soon ripened into intimacy.

The Lipari Islands were the next object of his researches : he examined them with great attention, and made them the subject of a separate work, entitled "*Voyage aux Iles de Lipari*," which was published in 1783.

The destructive earthquakes which desolated Calabria in the same year excited, as might have been expected, in an especial degree, the notice of Dolomieu. Repairing to the scene of ruin, he examined, with the most lively interest, the effects produced by this event on the face of the country, ascertained that the whole tract was covered by calcareous strata, without the smallest appearance of volcanic matter, either ancient or recent; and hence deduced some general principles on the nature and cause of earthquakes.

Sir W. Hamilton having in 1785 taken a slight survey of the five islands known by the general name of Ponza (Pontiæ insulæ of Pliny), which, with the islands Ischia and Procida, form an interrupted chain in front of the gulfs of Gaeta and Terracina, and having observed in them many interesting geological phenomena, suggested a more complete examination of them to his friend Dolomieu. He accordingly visited them in the spring of 1786, and brought back with him an abundant collection of specimens, and many observations of great importance to the general history of volcanos. These observations form the subject of his next publication, entitled "*Memoires sur les Iles Ponces,*" 8vo. which made its appearance in the year 1788. In the preface to this work he states, that he had long contemplated a detailed history of Etna, the largest, and loftiest, and most important active volcano which is readily accessible to Europeans; but that the encroachments upon his time, arising from monastic disputes and the necessity of adjusting petty interests, and of humiliating his adversaries, had reduced him to be merely a collector of individual facts for the use of others. From this complaint, which is made with some asperity, we may conclude that he took a warm and active share in the intrigues and dissensions which agitated the Order of which he was a member, and that the foundation was here laid of those resentments from which he suffered so severely some years afterwards.

On the breaking out of the French revolution, he returned to his native country; and, following the impulse alike of his feelings and of his friendship, arranged himself, together with the Duke de la Rochefoucault, among the partisans of reform. His conduct on this occasion appears to have been perfectly disinterested, for he occupied no office either of honour or profit, and appears, during his residence at Paris in the first years of the revolution, to have busied himself chiefly in the pursuit of his favourite study, and in the publication of a few papers on subjects intimately connected with it. The bloody fanaticism, following close on the steps of the revolution, which swept off so large a proportion of the public talent and virtue of France, although it spared the person of Dolomieu, inflicted on him the irreparable loss of his most intimate friend La Rochefoucault, who was barbarously murdered by a mob of assassins in the presence of his mother, his wife, and his friend. During the remainder of that period, emphatically called the reign of terror, proscribed, and making his escape from one asylum to another, he nevertheless found leisure to compose and publish two memoirs, one on the figures presented by the indurated marly slates of Florence, and the other on the physical constitution of Egypt.

The fury of the revolutionary storm was now for the most part overblown, and, among other encouragements offered to science by the new government, the Ecole des Mines and the National Institute were founded. The merits of Dolomieu obtained for him a seat among the members of the Institute, and he enriched the Journal des Mines with several interesting papers, among which may be particularly distinguished his history of the species beryl, intended as a model of the manner in which the history of minerals ought to be drawn up; and his memoirs on the heat of lava, and on leucite, in which he expounds his opinions on some of the principal questions relating to volcanos.

He now undertook a new journey to Switzerland and the south of France, and renewed his former acquaintance with Saussure; when the illustrious veteran formally devolved upon him the office of completing the survey of the Alps, which his own infirmities compelled him at length to relinquish, and of deducing from the multitude of important facts, the joint product of their several laborious journeys, some fundamental axioms in the science of geology. The extinct volcanos of Auvergne also attracted the special notice of Dolomieu during this excursion: being less encumbered by ejected matter than either the active or quiescent volcanos of Sicily and Italy, their connexions with the regular strata are much more easily traced, and many particulars of the very first consequence in their history, which elsewhere are the indirect result of dubious observation, offer themselves in full view to the student of Auvergne.

After an interval of six months thus employed, he returned to Paris, laid before the Institute a sketch of his labours, and made the commencement of a very extensive work on mineralogy, which he had long meditated, and which, founded on researches so extensive and so accurate, must of necessity have added greatly to our knowledge of volcanic rocks, as well as to the science in general.

Unfortunately for Dolomieu himself and for the public, the prosecution of this great design was interrupted by the offer of a situation in the expedition then preparing by Bonaparte for the conquest and colonization of Egypt. With the military rank of General, but probably with no other objects in view than those of science, in an evil hour he quitted the shores of France. The first blow struck by this great armament was the conquest of Malta; and in the arrangement of the articles of its surrender, Dolomieu was unwisely induced, by the joint persuasions it is said of the Order and of the French commander, to take a principal share. Bound by ties of allegiance to the sovereign authorities on each side, it was manifestly his duty not to interfere; and, involved as he had been in the party disputes of the Knights of Malta, there could be no doubt that his interference, even if really impartial, would render him extremely obvious both to wilful misrepresentation and to involuntary misunderstanding.

From Malta he accompanied the expedition to Egypt, and proceeded up the valley of the Nile as far as Cairo, from which place he meditated further excursions in pursuit of his favourite objects. His health, however, soon became seriously deranged, and he was obliged to seek for means of returning to Europe. Embarking at Alexandria, after a stormy passage, in which he narrowly escaped shipwreck, the vessel was obliged to take shelter in the port of Taranto. The day after their arrival, one of the sailors died of the plague, and of course the remainder, passengers as well as seamen, were placed in close custody. The Neapolitan territory was at this time in the crisis of revolutionary civil war, the one party being supported by the French, the other by the British and their allies : as each party obtained the temporary ascendency, Dolomieu and his companions ran the risk of being massacred, or were treated with high distinction. The French army being obliged to retreat from the south of Italy, the triumph of the royalists became confirmed, and Dolomieu, together with Cordier, General Dumas, and some other Frenchmen of distinction, were conveyed prisoners to Sicily. His companions being simply prisoners of war, were treated accordingly; but Dolomieu, by his conduct at Malta having subjected himself to the charge of a violation of allegiance towards the Order, of which the King of Naples was the acknowledged protector, was immediately separated from his friends, and placed in rigorous confinement, the severity of his treatment being probably aggravated by party animosity. Legal proceedings against him, if they were ever really contemplated, were suspended by the prompt interference in his favour of many distinguished persons, who nobly postponed on this occasion the gratification of political feeling in favour of their regard for science. The Danish government, M. D'Azara, the King of Spain, Sir Wm. Hamilton, and Sir Joseph Banks, made applications in his behalf, which, though not successful in obtaining his liberation, at least prevented the last extremity. At length the battle of Marengo was fought, which again laid Italy at the feet of France; and the first article in the terms imposed by the conqueror on Naples was the restoration of Dolomieu to his country and to science. In the mean time his philosophical associates at Paris had not been unmindful of their colleague, they having elected him to the Professor's chair, vacant by the death of Daubenton. His return to Paris was hailed with delight by his relations, his friends, and his colleagues ; and he entered on the duties of his office by the delivery of a short course of lectures on the general principles of mineralogy. For the restoration of his health, and in furtherance of his professional pursuits, he now undertook another journey to Switzerland, in the course of which he again reviewed and corrected his observations on the spots where they were originally made. Tearing himself at length, and with reluctance, from his beloved moun-

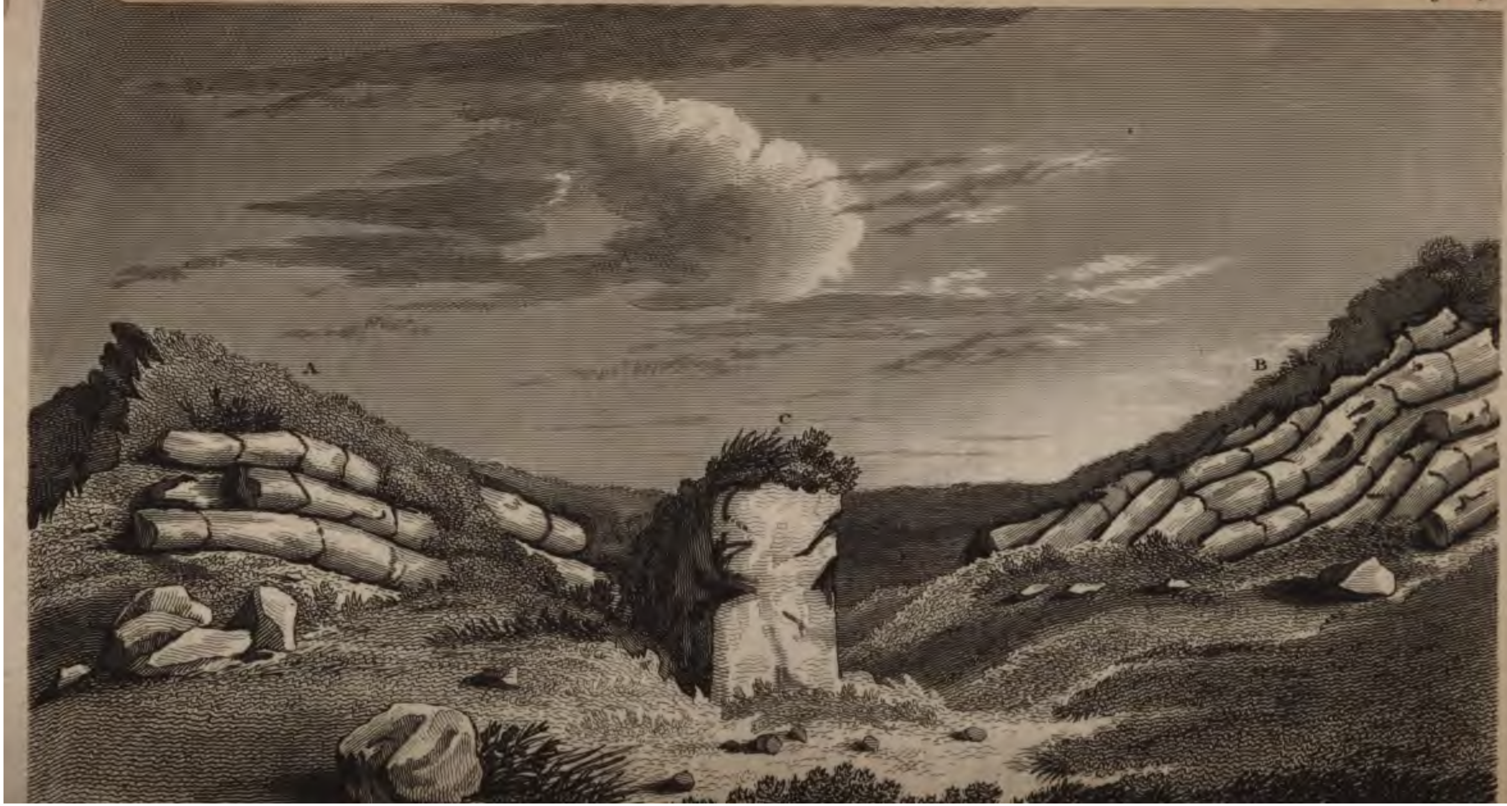
tains, as he was accustomed to call them, he returned, through his native town, to Châteauneuf, near Lyons, the residence of his brother-in-law, M. de Drée; and here, while enjoying the soothing attentions of friends and relations, and meditating further exertions in pursuance of his favourite science, he was attacked by a mortal disease, of which he died in the 53d year of his age.

From a careful perusal of the works of Dolomieu, especially his later ones, the following appear to be the results of his observations, and the bases of his geological system.

It appears highly probable from geometrical considerations, and from the theory of central forces, that the earth at the time when it received its spheroidical shape was in a state of fluidity. This fluidity was probably neither the result of igneous fusion nor of aqueous solution, but of the intermixture of a substance, or substances, with the earthy particles, fusible, like sulphur, at a moderate heat, capable of entering into more rapid combustion when exposed to the air, decomposing water, and involving the gas thus produced so as to enter into strong effervescence when the superincumbent pressure does not exceed a given quantity.

The surface of this fluid by the action of the air on the combustible ingredient which occasioned its fluidity, would at length become consolidated, and would envelope the whole spheroid with a shell of less specific gravity than the fluid part, and, therefore, floating securely on its surface; this latter essential condition being rendered extremely probable from the well-known fact that the mean specific gravity of the globe is considerably greater than that of any natural rock hitherto known.

The interposition of this solid shell of stony matter, a bad conductor of heat, between the liquid and the gaseous portions of the globe, would enable the aqueous and other easily condensible vapours to separate themselves from the permanently elastic gases, and thus the matter of the globe would be arranged in four concentric spheroids according to their respective gravities; namely, the liquid central portion, the solid stony, the liquid aqueous, and the permanently elastic. As the water penetrated through the stony portion to the nearest fluid part, it would be gradually decomposed, the consolidation would proceed downwards, the newly consolidated part would enlarge in bulk, and thus, aided by the elastic expansion of the hydrogenous base of the decomposed water, would occasion rifts of greater or less magnitude in the superincumbent mass. Some of the larger of these rifts would open a free communication between the ocean and the fluid central mass, a torrent of water would rush down, and the effervescence occasioned by its decomposition would produce the first submarine volcanos. The lava thus ejected would in time raise the mouth of the volcano above the surface *of the water*, when it would either become quiescent, or, if


A
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supplied laterally with a sufficient quantity of water, would assume the character of a proper volcano, or burning mountain. The secondary rocks, i. e. all those which either themselves contain organic remains, or are associated with those which do, were deposited from solution or suspension in water. By the deposition of these, and the increase by consolidation of the primitive rocks, the thickness of the mass incumbent above the central fluid is continually increasing; and those causes which anciently broke through the solid crust of the globe are now rarely able to produce the same effect; hence the greater magnitude and frequency of volcanic eruptions in the earliest ages of the earth; for the same reason the elevation of large, mountainous, or continental tracts above the general level no longer takes place; and thus the surface of the globe has become a safe and proper habitation for man and other animals. If the land animals were created as early as possible, that is, while the great changes of the earth's surface above-mentioned were still in progress, many of the most ancient traditions of deluges and other catastrophes may be founded on fact.

The fluidity of the central part of the globe, and its connexion with the active volcanos, affords a plausible theory of earthquakes, and particularly accounts for the propagation of the shock, with diminishing intensity, to great distances.

The crystals of hornblende, of felspar, &c. which occur so abundantly in most lavas are, according to this theory, not those component ingredients of rocks which have resisted the heat while the other substances associated with them have been melted; nor are they the result of the slow cooling of a vitreous mass, but are produced by crystallization in the central fluid, and are accumulated, on account of their inferior specific gravity, about its surface, together with the peculiar inflammable matter in which they float, whence they are disengaged during volcanic eruptions.

Article II.

An Account of some Basaltic Columns at Pouck Hill, Staffordshire, with Prehnite, Zeolite, and Barytes. By J. Finch, Esq.

(To the Editors of the *Annals of Philosophy.*)

GENTLEMEN, *Birmingham, June* 1, 1818.

Having perused, in the Geological Transactions, a valuable paper, written by Arthur Aikin, Esq. upon the greenstone occurring at Birch-hill colliery, near Walsall, I was induced to visit that spot. Having collected various specimens from the mouth of the pit, I observed that the roads were repaired with a different species of trap from that which I had just procured; and on inquiring whence it came, I was directed to Pouck Hill, where a quarry has been worked many years. This hill is situated one mile and a half north west from Walsall, at a short distance from Bentley Hall, which is noted in history as a place of concealment for Charles II. The estate belongs to Viscount Anson. On the north east it adjoins Birch-hill colliery, to which the ground descends by a gentle slope, and at the bottom a small stream of water forms a boundary between them. The distance from one hill to the other does not exceed half a mile.

By barometrical measurement, the highest part of the hill is 60 feet above the level of the colliery, and constitutes a part of the formation of trap, noticed by Mr. Aikin as forming an elevated ridge, which crosses that place. The basalt extends without any interruption from one to the other. It is about 30 feet lower than Bentley Hill, which is the highest land in the vicinity, and consists of gravel overlying the coal formation.

The extent of the trap may be estimated at nearly a mile in length. It varies extremely in breadth, from half a mile to 30 or 40 yards, which is the breadth at Birch-hill colliery. Pouck Hill may be regarded as situated near its centre. The opening of the quarry at this place has exposed to view some fine basaltic columns; many of them are four or five feet in diameter. After their crystallization on this large scale, they appear to have been subject to fissures, dividing them longitudinally; but the original hexagon can still be distinctly traced. Their length is various, some of the articulations being very short, and others extending to five or six feet. The direction of some is singularly waved, whilst others are straight; and from their lying in an almost horizontal position, they resemble at a distance the massy trunks of trees piled one upon another. Some of the basalt has attached to it a small incrustation of carbonate of lime in irregular spots. The trap of which this hill is composed is exactly similar to that of the Rowley Hills; of which an account is given by Dr. Thomson in the *Annals of Philosophy* for Sept. 1816. Those hills are at the distance of 10 miles, and no connexion can be traced between them.

Near the summit of Pouck Hill is a farm house, to supply which with water a well about 16 yards deep has been sunk in the rock, the lowest pump tree resting on a basaltic column. When the Birch-hill colliery was worked four years ago, the steam engine, employed to keep the mine free from water, drained this well, although at half a mile distance. The same effect was lately produced by cutting a deep trench on the opposite side of the hill beyond the boundary of the basalt. These two circumstances seem to prove, that this basalt is a superincumbent formation covering the coal. The stream already mentioned as separating Pouck Hill from the colliery, has worn itself a channel four feet deep; here the coal strata rise within a foot of the surface, and are covered by the trap in the unconformable manner usually ascribed to it.

The columns at the top of the hill dip at an angle of about 30 degrees in two directions, A, B; those on the north dipping south, and *vice versâ;* this appearance is caused by a fault, C, which crosses the centre of the hill from east to west. (See Plate LXXXIII.) This vein, or fault, is about five feet in thickness, including what appears like a wall on each side of one foot thick, which can be separated from the centre without any difficulty. This fault is as wide at the bottom as at the top, and its direction is exactly vertical. It consists of basalt or trap in such a state of decomposition that it cannot be ascertained whether it is exactly similar to the basalt forming the hill. It contains the following minerals:

Radiated zeolite, or mesotype of Haüy: occurs abundantly in nodular concretions. In the walls it forms thin veins, which penetrate the whole of the mass. Some of the specimens have considerable beauty. Occasionally the zeolite assumes the form of acicular four-sided prisms radiating from a centre.

Prehnite.—This mineral has not been found before in England. It occurs in massy, distinct concretions, rather abundantly, near the surface of the fault, imbedded in sulphate of barytes, and more rarely attached to the zeolite. Its colours are greyish white, greyish green, and greenish white. Its hardness very considerable.

Sulphate of barytes occurs both crystallized and in a loose state resembling sand, and constitutes the major part of the *top of the fault.*

I wish to acknowledge my obligation to the Rev. James Yates, of Birmingham, for his assistance in arranging the materials for this paper, for which purpose he has visited the spot. I have the honour to be, Gentlemen,

Your very obedient servant,

JOHN FINCH.

ARTICLE III.

Some Remarks on the Climate and Situation of Nice, with Observations on the Temperature and Weather taken in the Winter of 1816 *and Spring of* 1817. By a Correspondent.

(To Dr. Thomson.)

SIR, *London,* 1818.

DURING a residence of some months last year at Nice, in a climate so superior to our own, it was an object of some interest to myself and party to make daily observations on the weather and temperature, with a view of comparing them with those which we received from time to time from our friends in England. Since my return home I thought it might be an object of sufficient utility, in some respects, to be worthy of a little time and trouble, to put my observations into some kind of order, by arranging those of the temperature taken at Nice and in England * together on a common synoptical scale, by which a comparison could be more readily made between the two climates in respect of the changeableness and difference of temperature. I regret much that I was not furnished with a barometer, that I might have added observations with that instrument also into my table.

The latitude of Nice is about 43½ degrees north, or eight degrees south of London, and 7¼ degrees east of the same. The city, with its suburbs, is situated in, or rather surrounded by a rich plain, which may be about a mile and a half from east to west, and about two miles from north to the sea shore; it is bounded by a range of hills, which, beginning to the south east at the distance of about a quarter of a mile from the town, are continued as far round as the south west of various forms and gradations; and, like the successive benches in an amphitheatre, rise one above another until the snowy chain of the maritime Alps, about 8,000 or 10,000 feet high, appears like the boundary wall to the whole at a distance of about 25 or 30 miles. The city is situated near the shore, which immediately faces the south; and the river Paglion, which takes its rise among the neighbouring mountains, after flowing through the plain, enters the sea near the city walls. The sea is remarkable for the beautiful blue colour it generally exhibits, probably arising partly from the absence of tides, by which its waters, being so little disturbed, become highly transparent. After rain, however, the limestone washings from the neighbouring mountains tinge its waters to a considerable distance off the mouths of the rivers, which sometimes has a curious appearance. The deep blue colour of this sea may also be owing to its depth, which is very considerable off this coast; according to the measurement of Saussure taken about half a league off the Cape, between the ports of Nice and Villefranche, the depth was found to be 1,800 feet; it might also be observed by the great length of line used by the coral fishers who ply off this shore. Although little or no tide is perceptible in this sea, a southerly wind, or the approach of one, raises the ordinary level of the water some feet more or less upon this shore, and sometimes produces a very considerable surf. The sea breezes usually prevailed from about nine or ten, a. m. to four or five o'clock in the afternoon; and that was generally the case even when the upper current of wind came in quite a different direction. I remarked on one excursion to the

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* The observations of the temperature in England which I have used in my *scale are those of* Luke Howard, as published in the *Annals*.

summit of Mont Coa, about four miles north of Nice, that the sea breeze, which was felt so pleasant in the valley, did not prevail at that elevated station, about 2,000 feet. I occasionally observed, by the motion of the clouds, that the mistrale, or bise, (a north east wind so well known in Provence)* was passing over our heads, whilst the mild breeze from the sea was blowing upon us.

The sirocco, or south east wind, sometimes came on about sun-set in a brisk breeze, but at the same time with a mildness which at first quite surprized me; it was by no means relaxing, but very agreeable to the feelings; it generally ceased in the course of the night. The southerly winds sometimes blew with very sudden and rather violent squalls, which, however, commonly subsided in an hour or two.

The clearness of the atmosphere was very remarkable; the moon and the stars appeared very brilliant, and the lofty mountains of Corsica, with their snowy summits, were occasionally to be seen by the naked eye rising above the south eastern horizon at a direct distance of about 120 or 130 miles (English); their forms were most remarkable a few minutes before sun-rise, sometimes presenting very perpendicular sides, and often varying greatly in their apparent outline from day to day. This mountainous island very rarely appeared unattended by clouds even on clear, bright days; their forms, I remarked, were generally *Cumuli* (owing no doubt to the coldness of the atmosphere over the snows of those mountains); these *Cumuli* about sun-set sometimes presented a grand and richly coloured mass towering above the horizon to an immense elevation, reflecting the sun's rays for some time after the sun had gone down.

The clouds which appeared in the field of our observation sometimes afforded much interest in a meteorological point of view. From the concave and sheltered situation of the plain of Nice, so directly exposed to the south, the temperature of the surface of this plain, as well as of the superincumbent atmosphere, is rendered more or less considerable, especially as the sun gets up towards the meridian. The temperature of the lower stratum of air being increased, and consequently rarified, it is evident that the upper region of the atmosphere above us would also receive an increase of temperature, by the constant succession or supply of warmer air from the region below, which again (as it appeared) received its supply of cool air from the most open quarter, viz. from the sea. This sea breeze, as I have stated above, generally came on about nine or ten o'clock in the morning, by which time the sun was sufficiently elevated that its rays could bear upon the whole plain and sides of the hills with effect; the breeze generally increased till about two o'clock; and about sun-set subsided. This circulation, or ascending current of the warmer air, seemed to have at times considerable effect upon the clouds which happened to pass in our zenith, and which were not too elevated to be out of its influence. I have observed several instances of the atmosphere in the morning being quite overcast with clouds, and apparently (to an English eye) threatening rain, but which, about noon, became quite fine and clear; and in the afternoon the clouds, to my surprise, almost, and even wholly, to disappear (and this was not an uncommon occurrence). It was rare indeed during my stay there, that the sun was not to be seen and *felt* also in the middle of the day. In one instance a north westerly current brought up a quantity of clouds in detached *Cumuli*, which, when they had reached our zenith, were met by the sea breeze from S.E. which carried them all back, and in a short time disappeared. At other times they advanced to the summits of the neighbouring mountains, where they rested for the greater part of the day, assuming the *Cirrostratus* form. Thunder storms, I was informed, occurred very frequently in the summer, two or three times in the course of a week in the neighbourhood of the mountains, but that they seldom visited Nice (except at times during the spring). I had an opportunity of remarking this on the approach of a storm, one morning in the beginning of the summer.*

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* This wind (styled one of "les fléaux de la Provence), by which this part of France is so much visited, after passing over the High Alps and their immense snows and glaciers, takes its course with increasing violence towards the warm atmosphere of the Mediterranean; it is particularly violent in the valley of the Rhone. A friend of mine travelling from Avignon northward up this valley, while this wind was blowing with its usual fierceness, informed me that he did not appear to get clear of it until he had passed Lyons, although I found it still to prevail at Marseilles and Toulon for some days after. It is piercingly cold and dry, at the same time that it is violent, and in its course blows up the sand about the rivers and the limestone dust off the roads in vast clouds over the country, which is particularly the case about Marseilles, where on those roads there is so much traffic. It lasts in general several days, increasing in velocity and coldness as it seemed almost every hour. ("*Laissez-le*," said a native to me, with a significant shake of his head, in reply to my observation as this wind was coming on, that it was not so fierce as I was given to expect; and I had afterwards to remember his answer.) It is felt generally throughout Provence, particularly at Marseilles, Avignon, Montpelier, &c.

In this fine *Italian* sky, if so it may be called, the clouds, as a variety, often added much to the picturesque appearance of the landscape; it is not often, perhaps, that scenes are met with so beautiful and so highly picturesque of the kind as the north-east view of the town and rock of Nice, with the distant shores of

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* Extract from daily observations respecting this on June 2:—"Fine day: observed some finely illuminated *Cumuli*, with dark *Cirri*, traversing their sides, rising up above the mountains to the north: as they rose to a certain elevation, their summits gave way, and spread, as if acted upon by a different state of electricity, into a *Cirri* form; at length, about noon, several collected in the north into a dark, heavy mass of thunder clouds, discharging rain or hail over the mountains; the mass gradually approached our zenith, although the wind with us was blowing in a direction contrary to it; but before it reached our zenith, it seemed to have fallen into a different atmospheric medium, and I observed it soon began to fold itself backward, and in an hour or two the whole seemed to be gone, or merely to leave behind some light *Cirri*."

France over the Bay of Antibes, about sun-set, and the reverse view, viz. from the ramparts of Antibes, of Nice, with the mountains that rise behind it in successive ranges, and the snows of the Col de Tende, &c. bounding the picture.

The mildness of this climate, and the sheltered situation of the country about Nice, render it a fine field for the lover of botany to follow his favourite pursuit, a subject which I regretted I knew so little about. It was, however, interesting to attend to the geography of plants, which the gradual elevation of ground from the shore to the summits of the mountains rendered very remarkable, particularly in some species.

On the fertile plain of Nice flourished the orange and lemon trees in gardens (of which there were above 60 different kinds);* also the date palm (Phœnix dactylifera), the pomegranate (Punica Granatum), the Nerium Oleander, the cypress, different kinds of geraniums, the sweet-scented Verbena, the myrtle, one of the Gossypiums, or cotton tree, the olive, the white mulberry (Morus Alba), which supply the silk worms, and many other trees and plants; and on the walls and rocks in warm situations, the Cactus opuntia, or Indian fig, the caper shrub (Capparis Spinosa), the great aloe (Agave Americana), to be seen in some places ornamented with its stately flower 20 or 24 feet high. On ascending the hills a few hundred feet, but few of these were to be seen; the orange tree soon disappears; its region is very limited in distance from, and elevation above, the sea; with respect to the former two myriametres (about 11½ miles) has been stated by Risso to be its limit. The olive region may be traced considerably higher up the hills, higher on their south sides than on the north; this region, as near as I can guess, does not much exceed in general 800 or 1,000 feet in elevation; its distance from the Mediterranean I found, when travelling northward from Marseilles, to be about 70 or 80 miles; it dwindles away to a mere bush between Avignon and Pont d'Esprit, about which place I lost sight of it. Above the olive region generally appeared the Pinus Abies, the Pinus Sylvestris, or Scotch fir, Juniperus Communis, the chesnut (Castanea vesca), &c.; upon this region the snow in winter sometimes fell, and remained for a longer or shorter period, according to circumstances.

Some attention to the geography of plants is useful in choosing a situation most advantageous for an invalid whose case

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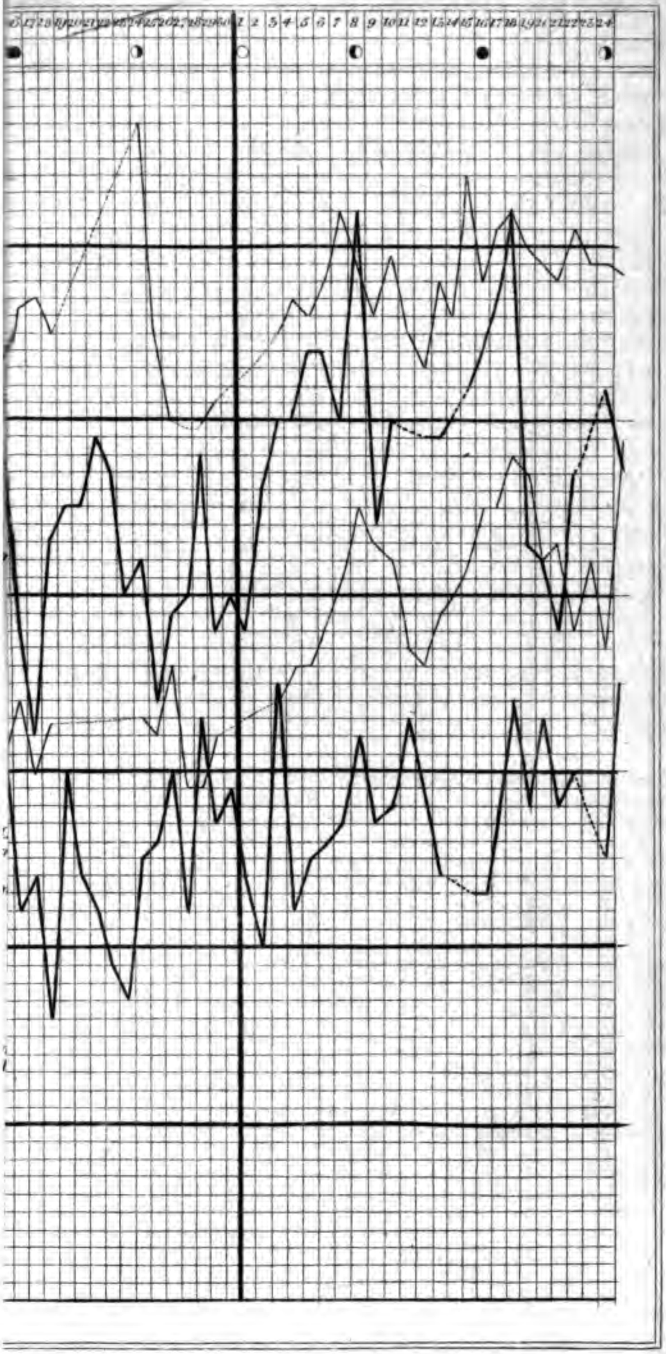
* In a small publication, by Risso of Nice, of the different kinds of orange, lemon, and lime trees cultivated in the Dep. des Alpes Maritimes, he divides them as follows:

Species of the Orange (Orangers)	19
———— Bitter ditto (Bigaradiers)	11
———— Limetiers (Limes)	7
———— Cedratiers (Cedrat)	3
———— Limoniers (Lemon)	25
	65

requires a warm climate; thus the olive and orange trees may serve as useful subjects in this respect for the south of France. About Aix and Nismes the olive is but a humble, lean-looking bush, or standard, from about four to 10 or 12 feet high, requiring the use of the pruning knife to bring it into condition for a crop every other year: at Marseilles it increases in stature, appearing as a small tree; at Nice it becomes a fine thick tree, about 20 or 30 feet in height, bearing annually, and apparently but seldom pruned; and about two miles to the east of Nice, near the town of Villefranche, a situation peculiarly sheltered and exposed to the south, this tree appears to great perfection, and affords an excellent, hard, and close-grained timber, which is a good deal worked by the cabinet-makers and carpenters at Nice. Again, the orange tree flourishes and brings its fruit to perfection in the plain of Nice (some few of them under shelter of Mont Cimiez I should guess were from 25 to 30 feet high); the fruit is still finer in flavour and earlier matured at Villefranche; the tree is also well cultivated and in high perfection at Hyeres, though I understand that at Toulon, about nine miles only distant, it requires the shelter of a wall, and at Marseilles the shelter of a greenhouse in winter. And even in the neighbourhood of Nice, it might in the same manner be observed, that some situations were much more eligible than others in point of shelter and warmth, though not so evident at first sight. After a visit by a very cold, bleak, and violent mistrale in the month called April, its mischievous effects were very observable upon the tender vine shoots as well as upon the young green leaves of the mulberry trees, in shrivelling them as if they had been burned, leaving but a poor prospect for the next vintage, and throwing back considerably the ensuing crop of silk. I observed these effects particularly between Antibes and the valley of the Var; also in many situations in the valleys about Nice, which ran north and south; but in other places on the south sides of the hills, the mulberry trees mostly escaped uninjured, and in some instances were to be seen in a flourishing state at a little distance from others which were blasted, but which had not been so protected. The most protected situation about Nice appeared to me to be the south side of Mont Cimiez, or the plain between it and the shore, which includes the *Croix de Marbre,* a quarter the most frequented by the English. Villefranche is undoubtedly a warmer and more sheltered spot, but it is a place not to be compared to Nice for accommodations, or even the necessaries of life, at which place the now frequent visits of our countrymen for the benefit of the climate have afforded the inhabitants the opportunity of learning English wants and comforts. With respect to our consumptive patients visiting so distant a spot for the benefit for the climate, it appeared clear that unless they decide to go there at such an *early stage of* the disease when they are able to take the air

May


17 18 19 20 21 22 23 24 25 26 27 28 29 30 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

exercise which this fine climate allows of with so little inter- ion, the experiment would seldom prove successful. The ney itself, of 800 or 1,000 miles, although alleviated by a and easy water conveyance from Chalons to Avignon, is of f a heavy, and it may be a painful toil to inflict upon the ɜrer; yet the earlier the decision is made, the greater appears ›e the probability or certainty of success, or recovery. I e I may be excused for thus deviating a little from the inal subject of this communication; but I am led to do so :he hope of dropping a hint or two that might be useful at o any concerned, or likely to be concerned, with the subject. 'pon the annexed scale (Plate LXXXIV), the maximum and imum of temperature for each day at Nice, taken by a Six's ble thermometer (suspended about 15 feet from the ground ı north aspect), are compared with those of L. Howard, as lished in the *Annals*. It may be observed how uniform the y temperature was at Nice comparatively with that in ;land, the line indicating the maximum at Nice having for the :e winter months mostly confined itself within the 50th and h degrees of Fahr.; whilst that of England has marched ing the same period between the 30th and 55th degrees, its rp, angular course indicating the rapid changes of temper- re in our English climate. It may also be observed how rly the great depressions and elevations of temperature in the › countries correspond in point of date.

The following is a brief, daily account of the weather at Nice.

ay.	Wind.	Remarks.
ı16.		
:c. 1	N	Fair; windy.
2	N	Very fine; clear; warm sun.
3	E	The same.
4	E	The same.
5	NE	Cloudy; mild.
6	N	Cloudy; very mild.
7	NW	The same.
8	W	Cloudy; fine; *Cumuli*.
9	SE	Rain about sun-rise; fine at noon.
10	NE	Cloudy.
11	W	Cloudy; haze.
12	SE	Fine, and warm sun.
13	SSE	Wet mists; drizzling rain.
14	W	Fine, and about noon very clear.
15	W	A little rain; clouded sky.
16	NW	Fine; very mild evening.
17	NW	Fine; hot sun.
18	W	Very fine and warm.
19	E	Fine; wind cold; a gale of wind at seven p. m. from E.
20	NE	Clouded day; the mistrale cold.
21	NE	Fine; cold wind; observed four spots in the sun.
22	NE	Fine; clear; cold wind.
23	N	Very fine and clear.
24	N	Brilliant day; scarce a cloud.
25	E	*The same.*

Day.	Wind.	Remarks.
1816.		
Dec. 26	E	Cloudy, but pleasant.
27	W	Cloudy; *Cumuli;* at noon clouds went off; fine and warm.
28	NW	Fine.
29	N	Fine; *Cirri; Cirrostrati.*
30	SE	Very fine; warm sun.
31	SW	Cloudy, but pleasantly mild.
1817.		
Jan. 1	E	Cloudy; wet mists, and a gentle shower; little or no wind.
2	E	Light rain.
3	W	Rainy.
4	N	Fine, clear day; warm at noon.
5	N—E	Fine; warm; clear; *Cirri.*
6	WSW	Fine; thermometer rising rapidly, with a SW wind, to 63¼ in the shade.
7	NW	Fine; cold wind.
8	N	Fine; clear; cold wind.
9	NW	Brilliant day, after a frosty night; *Cumuli* over sea.
10	NE	Fine.
11	NE	Fine.
12	E	Rain last night; cloudy; windy.
13	NW	Fine; warm at noon; one or two finely formed *Cumuli* were to be seen over Corsica towering high above the horizon, with *Strati* traversing them; sea calm.
14	NW	Fine, and warm.
15	W	The same: at 11 p.m. some distant lightning.
16	N	Very fine and clear; no cloud that I saw.
17	N	Fine morning; afterwards cloudy, and a few drops of rain fell.
18	E	Rain almost the whole day.
19	SE	Heavy gales off the Devonshire and Cornwall coasts; very rainy; clouds hanging upon the low hills.
20	SE	Heavy gales off the Devonshire and Cornwall coasts; storm of wind and heavy rain last night; rivers flooded.
21	NE	Cloudy; an additional coat of snow on the mountains since these two or three days past.
22	E	Very fine and warm.
23	NE	Fine; afterwards, clouded sky.
24	NE	Fine, and warm.
25	E	Very fine; sultry, with the mist of an English summer's day.
26	E	The same.
27	NE—SE	Fine: a Mediterranean mist came towards us from the sea after yesterday's warmth.
28	W	Fine, and warm.
29	E	The same.
30	NE	The same.
31	NE	Very fine and clear.
Feb. 1	NE	Very fine; hot sun.
2	SW—NE	Very fine; windy at night.
3	NE	Very fine.
4	NE	Fine, and warm; fine night as usual.
5	ENE	The same; *Cirrostrati.*
6	NE—SW	Very fine; *Cirri.*
7	E—S	The same; sea breezes.
8	N	Fine, and very warm sun.
9	E	Fine; sirocco in the evening; clouded.
10	NE—E	Cloudy morning; fine at noon.
11	SE—E	Clouded sky.
12	W	The same.
13	NE	Very fine, and hot sun.
14	NE—W	The same; *Cirri* about nine p.m.: a thunder storm; lightning very vivid, with some rain.

Day.	Wind.	Remarks.
1817.		
Feb. 15	N—S	Fine; *Cirri.*
16	N—S	Very fine; a few *Cirri.*
17	NW—SW	Very fine and clear; a few *Cirri.*
18	N—S	The same.
19	N—S	The same.
20	—	The same.
21	—	The same.
22	NW	The same; much wind; a gale at one time.
23	NW—E	Brilliant day.
24	N—E	Cloudy.
25	N	Very fine and clear.
26	NE—S	The same.
27	SE—NW	Very fine; the upper current (NW) descended upon us in the evening as the sea breeze fell.
28	E—SE	Very fine; clear sky.
March 1	NE	Very fine.
2	N—SE	Very fine, and warm.
3	N—SW	Very fine; therm. at 67½.
4	W	Fine; therm. at 73; a hard gale to-day.
5	W—SW	Much wind; dark *Cumulostrati.*
6	N—W	Fine; but as the west current came on, clouds and a haze came up.
7	W	Fine day; much wind.
8	NW	The same.
9	N—NW	Very fine.
10	NW	Very fine; windy.
11	N—SE	Very fine; windy.
12	N	Fine.
13	N—SE	Very fine.
14	N—SW	Fine morning; cloudy afternoon.
15	N—SE	Very fine; cloudless.
16	NE—SE	Very fine.
17	E	Cloudy; very cold; a few drops of rain.
18	N—S	Very fine.
19	N—ESE	Very fine.
20	N—E	Fine morning; at night, cloudy and rain.
21	N—E	Rain, a.m.; fine, p.m.
22	N—S	Much snow fallen on the distant Alps; fine, a.m.; cloudy, p.m.
23	N	Cloudy, but mild.
24	N—S	Fine.
25	N—S	Very fine.
26	E—S	Very fine.
27	N—E	Very fine.
28	N—NE	Very fine morning; hazy, p.m.
29	N—SE	Very fine.
30	N—SE	Very fine.
31	NE—E	Very fine; evening windy.
April 1	E	Cloudy; fine, p.m.
2	E—SE	Fine.
3	SE	Fine.
4	E—SE	Fine.
5	E	Very fine.
6	E	Fine.
7	E	Fine.
8	E—SE	Fine.
9	—	Cloudy.
10	—	Fine.
11	—	Cloudy; showery.
12	—	Fine.

Day.	Wind.	Remarks.
1817.		
April 13	—	Fine.
14	—	Cloudy.
15	—	Fine day.
16	—	Fine.
17	—	Rainy.
18	—	Fine.
19 to 23 omitted.		
24	N—SE	Very fine.
25	NE—SE	Very fine.
26	NE—SE	Fine.
27	N	Rain; snow on the mountains; very cold.
28	N—S	Fine, and clear.
29	N—SE	Fine; and cloudy, p. m.
30	NE	The same.
May 1 and 2, omitted.		
May 3	E	Fine; wheat in the ear.
4	SE	Very fine.
5	SE	Very fine, and clear of clouds.
6	SE	Very fine.
7	SE	Fine; hazy.
8	E	Hazy; clouds reticulated; a brisk E. wind; a firefly seen.
9	SW	Cloudy; showery.
10	SW	Fine morning; large *Cumuli* above the mountains.
11	S	Heavy rain early, a. m.
12	E	Very fine and clear.
13	SE—NE	Fine day, and clear; but the N.E. current brought up clouds, p. m.
14	SE	Fine; cloudy; *Cirrostrati*.
15	SE	Fine; very hot; *Cirrostrati*.
16	SE	Hazy; some rain; fresh breeze.
17	E	Very fine, and hot; contorted *Cirri* in the zenith; soon after, a breeze.
18	E	Clouded, with a very hard easterly gale throughout the day; a few drops of rain.
19	ESE	Overcast; dark *Cirrostrati* over a *Nimbus;* rain began towards dusk, but slight.
20	S	Clouds very low; rain, a. m.; as the sun got up, the clouds were penetrated, and began to move away; one part rose in a mass to a great elevation, the summit assuming a very fine *Cumuli* form, reflecting the rays of the sun in a dazzling manner.
21	SSW	Very clear and fine; the snow on the Corsican Alps distinctly visible, lying in the defiles distant about 120 miles.
22	SW	Fine, a. m.; fine *Cumuli*, one of which broke over one of the mountains, whitening it with snow, or hail; another broke over us with a few drops of rain; some lightning over the mountains in the evening.
23	SW	Very fine and clear morning; some plumose *Cirri* overhead, and the wind soon got up from W.S.W. to a stiff breeze, and brought up a haze.
24	SW	Very fine and bright; a fine *Cumulus*, highly illuminated in the N., over the summit of one mountain.
25	SW	Cloudy; some rain; fine, p. m.
26	SW	Cloudy; some rain; afterwards sky cleared, and brilliant afternoon.

Day.	Wind.	Remarks.
1817.		
May 27	SW	Fine; windy; *Cirri.*
28	SW	Very fine; windy.
29	W	Fine; windy; *Cumuli.*
30	SE	Fine; *Cirri.*
31	SE	Fine.

SIX MONTHS OF OBSERVATION.

Very fine, or fine days, about	130
Rainy, or on which any rain fell to my knowledge.	27

Article IV.

Memoir relative to the Annular Eclipse of the Sun, which will happen on September 7, 1820. By Francis Baily, Esq.

[The following essay, a few copies of which have been printed for private distribution, was transmitted by the author to the Editors of the *Annals*. The interesting nature of the subject will, they are persuaded, render it acceptable to their scientific readers.]

The solar eclipse which will happen on Thursday Sept 7, 1820, will be the greatest of all those which have happened in this part of Europe ever since the year 1764; and indeed of all those which will again happen here before the year 1847. Like the two eclipses above alluded to, it will be *annular*: that is, the disc of the moon will not wholly cover the disc of the sun; but, in certain parts of the earth, the sun will show the appearance of an *annulus*, or ring, round the body of the moon; the position and magnitude of which will depend on the situation of the spectator. In no part of England, however, will this annular appearance be observed:* but, on the continent, in any part of that tract of country which extends nearly in a straight line from the north of Westphalia to the south of Italy, the inhabitants will have an opportunity of beholding this singular phenomenon.

Annular eclipses do not appear to have been noticed by the ancients, who probably confounded them with partial ones. Indeed, the only authentic accounts of any well observed annular eclipses in this part of Europe (besides the one in 1764 abovementioned) are those of Feb. 18, 1736-7, and of July 14, 1748;†

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* The eclipse, however, will be annular in the Shetland islands: and it will be of considerable magnitude along the whole eastern coast of Great Britain.

† See a detailed account of these eclipses, and of the phenomena attending them, in the Phil. Trans. vol. xl. p. 177, and vol. xlv. p. 582.

the former of which was observed by the celebrated Colin Maclaurin at Edinburgh, and the latter by the Earl of Morton and Mr. Short, at Aberdour Castle, near the same place. Indeed the annular appearance of the eclipse of 1737 was confined principally to Scotland; and the eclipses of 1748 and 1764, although visible to a great part of Europe, were not so generally observed as could be wished, on account of the badness of the weather; so that we have not any very considerable degree of information respecting this kind of solar eclipses. Moreover at those periods the lunar tables were so defective that it could not be predicted, with any degree of accuracy, *where* the annular appearance would be visible; so that many valuable observations were probably lost on that account. This difficulty, however, is in a great measure removed by late improvements, not only in the lunar tables, but likewise in the analytical investigations relative to the calculation of eclipses; although the computations are still very laborious and troublesome.

Prior to the total eclipse which took place in London in the year 1715, Dr. Halley published an account of the path of the moon's shadow across the island of Great Britain; and called on the inhabitants to note down their observations and forward them to him, in order that he might afterwards compare them, and thereby correct the elements made use of in the calculation of eclipses. The good effect of this measure may be seen in the report which that illustrious astronomer afterwards drew up, and sent to the Royal Society, and which is inserted in the Phil. Trans. No. 343, vol. xxix. p. 245. Mr. Maclaurin, likewise, previous to the annular eclipse in 1737, before mentioned, wrote to several persons in the country, "desiring that they would determine and note down the duration of the annular appearance as exactly as possible, in hopes, by comparing their observations, to have traced more correctly the path of the centre and limits of the phenomenon." And in 1748 Mr. Alexander Monro (Professor of Anatomy of Edinburgh), by Mr. Short's desire, wrote to all his friends in different parts of the country, to prepare in the best manner they could for the most exact observation of the annular eclipse which was about to take place in that year. And he regrets that he did not make this application earlier; for he remarks that had "my request of having the duration of the annular appearance measured been made more public before the eclipse (after Dr. Halley's example in 1715), I doubt not but I should have been able to have given a more exact account of the progress of the centre of this phenomenon and of its limits." M. de L'Isle also, with a similar view, published a notice to astronomers * in order, as he observes, "exciter les curieux de l'Europe, qui pourront voir l'éclipse

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* *Avertissement aux astronomes sur l'éclipse annulaire du soleil que l'on attend le 25 Juillet*, 1748. It was published, however, only three months prior to the eclipse taking place; so that there was scarcely time for it to get into general circulation.

annulaire qui doit arriver, d'y apporter toute l'attention possible, et de faire, de bonne heure, toutes les dispositions nécessaires pour la bien observer; afin de nous procúrer tous les avantages que l'on en peut retirer pour l'astronomie, la géographie, et la physique."

It is worthy of remark that this eclipse (1748) was the first that the celebrated Lalande (to whom the astronomical world is so much indebted) ever saw. He was then only 16 years of age; and the impression which it made on him fixed his future pursuits in life, and induced him to become an astronomer. It indeed excited so much attention in Europe, that the King of France (Louis XV) went purposely to Compiegne in order to observe it, attended by the Abbé Nollet, and Messrs. de Thury and de la Condamine; and furnished with every convenient instrument for the purpose. The royal astronomer there made several important observations.[*] M. Lemonnier likewise undertook the journey from Paris to Edinburgh, furnished with proper instruments, purposely to observe it during its annular appearance; and he afterwards published some important remarks thereon.[†] M. de L'Isle, above-mentioned, published also a paper on the subject, entitled "*Nouvelle Théorie des Eclipses,*" founded entirely on the recent observations that had been made.[‡] M. Pingré afterwards added very considerably to these reflections in his interesting memoir, entitled "*Recherches sur la Longitude des plusieurs Villes.*[§] Méchain likewise made a great many calculations relating to it, from the manuscript collections of M. de L'Isle. But it was reserved to Lalande, *fifty years after the event,* to deduce the most important conclusions from this singular phenomenon, in his paper "*Sur la grande Eclipse Annulaire de* 1748."[||]

Considering, therefore, the interest which has always been attached to this kind of phenomena, and the important conclusions to be drawn from them, I was somewhat surprised to find that no particular notice has been taken of the ensuing eclipse either in the Connaissance des Tems, or in the Nautical Almanac; but that it is merely announced there in the usual formal manner, without a single remark on the occasion. It is true that M. Bode, in his ephemeris, published at Berlin, has given (as usual) a general outline of the eclipse, together with a map descriptive of the phases; but he has not called on the inhabitants to look out for this phenomenon, nor drawn their attention to any of the subjects which it is most desirable they should observe. In order to supply this defect, as far as my humble efforts will avail, I have drawn up the following memoir, under the hope that it may induce others, who have more leisure, and are at the same time more conversant with the subject than myself, to pursue the inquiry, and suggest further hints to those who may have an opportunity of observing this rare phenomenon.

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[*] The same monarch had also made several observations on the eclipse of 1737, at Versailles, attended by the celebrated Cassini.

[†] See the Memoires de l'Acad. Roy. des Sciences for 1765, p. 463.

[‡] Ibid. for 1757, p. 490.

[§] Ibid. for 1766, p. 17.

[||] See Memoires de l'*Institut*, (Scien. Math. et Phys.) vol. ii. p. 364.

M. de L'Isle, in his *Avertissement* above alluded to respecting the eclipse of 1748, suggested the advantage and propriety of some scientific person in the principal states of Europe through which the shadow of the moon's umbra passed undertaking to announce to the inhabitants the several observations which it would be proper for them to make; and afterwards to collect and arrange such observations for further investigation, if sufficiently convinced of their accuracy. A similar plan might be adopted in the present instance; and, from the more general diffusion of science, would be more likely to be attended with a beneficial effect. Such collections of observations (when made) should be sent by the different collectors to one or more of the principal astronomers of Europe, in order that they might be finally investigated, and the result laid before the public.

With that view I would take this opportunity of requesting those into whose hands the present memoir may fall to circulate it as much as possible on the continent, and amongst those persons who, from their connexion with any foreign literary journal, may be likely to diffuse the subject of it amongst the inhabitants of that part of Europe and Africa where the annular appearance will be observed. Such of our own countrymen, likewise, that may be travelling in any of the provinces on the continent here alluded to, will promote the interest of astronomy if they would carefully note down or collect any of the circumstances hereinafter alluded to, or indeed any other remarkable phenomena that may happen during this eclipse. I shall be happy to receive any observations of this kind that may be forwarded to me, and will preserve the result of them, as above proposed, for a future investigation.

The elements of the present eclipse I have computed from M. Burckhardt's tables of the moon, and M. Delambre's tables of the sun; and they are as follow. The ecliptic conjunction will take place on Sept. 7, 1820, at

$$\left.\begin{array}{l}1^{h}\ 51'\ 37''\ 3\ \text{p. m. } \textit{apparent} \text{ time, or}\\ 1\ \ 49\ \ 26\ \ 2\ \text{p. m. } \textit{mean} \text{ time} \ldots\ldots\end{array}\right\}\text{at Greenwich:}$$

And at that time we shall have the

True longitude of the luminaries	5ˢ	14°	47′	40·7″
True latitude of the moon (north)..........	0	00	44	39·4
Moon's horary motion from the sun.	0	00	27	1·7
——— horary motion in latitude (decreasing)	0	00	2	42·0
——— horizontal parallax..............	0	00	53	53·0
——— *semidiameter*..................	0	00	14	41·0

Sun's semidiameter	0s	00°	15′	54·8″
—— horizontal parallax	0	00	00	8·7
—— declination (north)	0	5	59	41·0

From these elements it may be determined that the moon's shadow first touches the earth's disc at 11h 23′ a.m. *apparent* time at Greenwich, in N. lat. 59° 43′, W. long. 90° 50′;* and that it finally leaves it at 4h 39¾′ p.m. *apparent* time at Greenwich in N. lat. 3° 21′, E. long. 20° 25′. Consequently the total duration of the general eclipse to the inhabitants of the earth will be about 5h 17′; but at no one place in particular will the duration be much more than half that time.

The *central* path of the moon's shadow across the earth's disc, which is the most material circumstance in inquiries of this nature (since it serves to point out those parts of the world where the eclipse will be seen annular), may be determined with considerable accuracy from the principles laid down by M. Delambre in his "*Traité d'Astronomie*" (vol. ii. p. 384); and, agreeably to the formulæ which he has there given, I have carefully computed the following table, which shows the several points (expressed by positions of latitude and longitude) through which the centre of the moon's shadow will pass in its progress across the earth's disc at the several times therein mentioned. The first column denotes the *apparent* time at Greenwich at the moment when the centre of the moon's shadow passes the given points laid down in the second and third columns, and the last column shows the corresponding apparent time *at those places*.

Apparent time at Greenwich, p. m.	Latitude North.	Longitude from Greenwich.	*Apparent* Time at the Place.
12h 54′ 39″	81° 39′ 29″	W. 149° 32′ 55″	2h 56′ 27″ a. m.
55 0	83 39 34	129 44 37	4 16 2
1 0 0	82 24 34	42 38 12	10 9 27
8 16	76 6 21	17 3 15	12 0 0
10 0	75 23 11	14 31 41	12 11 53 p. m.
20 0	69 9 41	5 52 11	12 56 31
30 0	64 13 27	0 46 50	1 26 53
40 0	59 47 31	E. 2 50 42	1 51 23
50 0	55 44 40	5 48 32	2 13 14
2 0 0	51 56 26	8 26 4	2 33 44
10 0	48 18 42	10 57 6	2 53 48
20 0	44 49 25	13 32 32	3 14 10
30 0	41 25 32	16 23 32	3 35 34
40 0	38 3 53	19 44 0	3 58 56
50 0	34 40 41	23 59 43	4 25 59
3 0 0	31 7 19	30 24 13	5 1 37
6 11	27 10 30	46 2 4	6 12 19

From this table it will be seen that the *central* eclipse commences in N. lat. 81° 39′ 29″, W. long. 149° 32′ 55″, when the sun and moon will rise together (the centre of the moon being directly on the centre of the sun's disc) to the inhabitants of that part of the globe, at $2^h\,56'\,27''$ in the morning, corresponding to $12^h\,54'\,39''$ (or $0^h\,54'\,39''$ *) in the afternoon at Greenwich: that the sun will be centrally eclipsed on the meridian (or exactly at noon) in N. lat. 76° 6′ 21″, W. long. 17° 3′ 15″, when it is $1^h\,8'\,16''$ in the afternoon at Greenwich; and that the sun will set centrally eclipsed in N. lat. 27° 10′ 30″, E. long. 46° 2′ 4″ at $6^h\,12'\,19''$ in the afternoon, corresponding to $3^h\,8'\,11''$ at Greenwich.

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* All the longitudes *in this memoir* are reckoned from the meridian of Greenwich.

If the points mentioned in the second and third columns of the above table be marked on a good map, and lines be drawn connecting these points, we shall have the path of the centre of the moon's shadow across the globe. Whence it will be seen that the centre of the shadow, having entered the earth's disc near the North Pole,† will proceed between the Shetland islands and the coast of Norway down the North Sea, and enter the continent of Europe on the coast of Westphalia, about half way between the Ems and the Weser. It will thence proceed, nearly in a straight line, across Germany and the Tyrol country, and enter the gulf of Venice about mid-way between Trieste an Venice. Traversing that gulf it will cross the heel of Italy; and, after skirting the coast of the Morea and Candia, will pass directly over Alexandria in Egypt, and finally leave the earth in Arabia, near the Persian gulf.

If we set off two other lines on the map parallel to this central line, one on each side thereof, and each at the distance of about 130 geographical miles from the central line, the intermediate space between these two boundary lines will nearly ‡ represent the path of the moon's *umbra;* and will show all those places where the eclipse will be seen *annular*, or where the whole body of the moon will appear on the face of the sun. Some uncertainty, however, may exist with respect to those towns which are situated near the *borders* of the umbra, such as Rotterdam, Aix la Chapelle, Liege, Treves, Freyburg, Parma, Rome, and other places on the one side; and Magdeburg, Leipsic, Ragusa, Athens, and other places on the other side of the central path; since the eclipse may or may not be annular in the neighbourhood of those towns according to circumstances. Nevertheless at all those places, and indeed to the whole of Europe and to a

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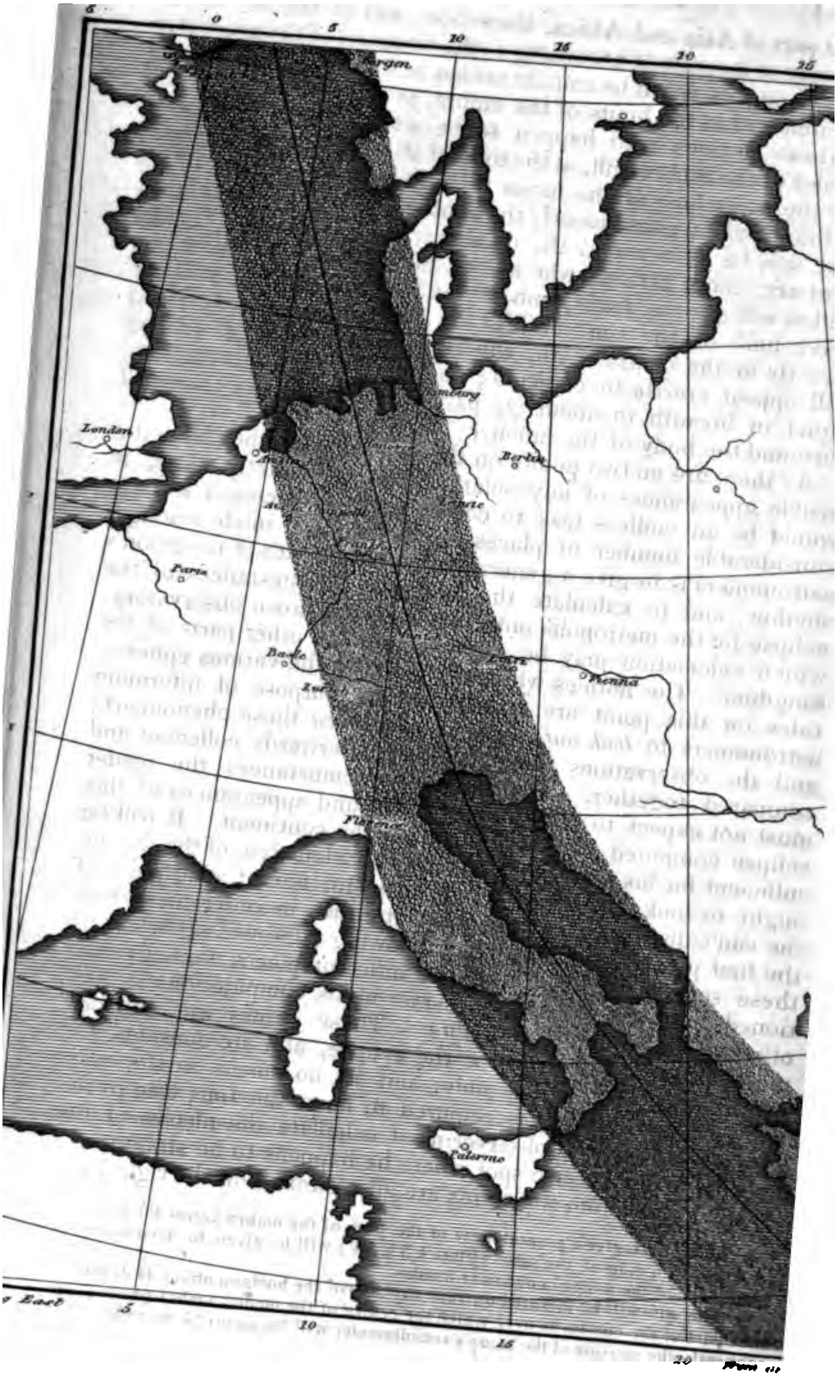
* That is, 54′ 39″ after 12 o'clock *at noon*. The English astronomers begin the day at noon; but the French reckon from midnight, as in the civil mode of reckoning. There cannot, however, be any ambiguity in the present case as to the 12^h.

† It will traverse the supposed *polar basin*, and the north east coast of Greenland, the object of so much laudable curiosity at the present moment; so that if the adventurous navigators to those parts should not have returned before the date of this eclipse, they will probably observe it in those high latitudes.

‡ It must be evident to those acquainted with the principles of astronomy, that the umbra will not be exactly of the same width in any two points of its course; but will be constantly varying. It will not, however, undergo any material alteration in its progress across the continent of Europe.

Pl. LXXXV.


5
0
5
10
15
20
25
Bergen
London
Hamburg
Berlin
Leipzic
Paris
Basle
Zurich
Linz
Vienna
Florence
Palermo
East
5
10
15
20
from

great part of Asia and Africa, the eclipse will be visible; differing only in magnitude according to the situation of the spectator. But, in no part will it be annular except at those places which are situated within the limits of the umbra, as above-mentioned.*

Those persons who happen to be situated on the *western* border of the umbra will, at the time of the middle of the eclipse, see the *upper* limb of the moon in contact with the *upper* limb of the sun; and consequently the unobscured portion of the sun's disc will be seen round the under part of the moon. On the contrary, those persons who are on the *eastern* confines of the umbra will see the *lower* limb of the moon in contact with the *lower* limb of the sun. Whilst to those who are stationed directly in the central path, the centres of the sun and moon will appear *exactly* to coincide; and an uniform luminous ring, equal in breadth to about $\frac{1}{29}$ part of the sun's diameter, will surround the body of the moon.†

As there are no two points on the face of the globe where the visible appearances of any solar eclipse are exactly alike, it would be an endless task to compute the phenomena for any considerable number of places; and the usual mode amongst astronomers is to give a general outline of the path of the moon's shadow, and to calculate the particular circumstances of the eclipse for the metropolis only, or for some known observatory; which calculation may be easily adapted to other parts of the kingdom. The notices which are given in the various ephemerides on this point are merely for the purpose of informing astronomers to *look out* for, and *note down* these phenomena; and the observations thus made are afterwards collected and compared together. Under these circumstances the reader must not expect to find the exact time and appearances of this eclipse computed for every place on the continent. It will be sufficient for his purpose if he knows at what time of the day he ought to look out for its commencement, and at what point of the sun's disc he ought to fix his attention in order to observe the first point of contact. The following table will show nearly these several particulars for the different places therein mentioned; and will assist the observer in his computations for any other place within the umbra. These values are deduced merely from a *projection* of the eclipse, and are consequently given as approximations only, and by no means as the *exact* values; for, where it is required to have the time true to the nearest second, the observer must calculate the phases of the eclipse for the precise spot where he happens to be stationed.

The angles from the vertex are all reckoned on the right hand side of the sun, as the moon always makes the first impression on the sun's disc on that side.

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* In order to give a general view of the path of the umbra across the continent Europe, a map of the same (Plate LXXXV) will be given to accompany the mainder of the paper in our next number.

† The sun will be elevated on that day above the horizon about 34 degrees to that part of the continent over which the centre of the moon's umbra passes; consequently the *increase of the moon's* semidiameter will be about 7¾ seconds.

Place of Observation.	Time of Commencement.		Angle from the Vertex.
	Mean Time at Greenwich, p. m.	*Mean* Time at the Place, p. m.	
Lerwick (Shetland)....	12^{h} 9′	12^{h} 3′	52°
Bergen (Norway).	15	37	61
Amsterdam	26½	46	58
Aix la Chapelle.	30	54	61
Hamburg	31	1 11	65
Leipsic..............	37	26½	71
Frankfort............	34	8½	64
Lintz.	44½	41½	76
Munich.............	42	28	70
Zurich	39	13	65
Venice	48	37½	72
Florence	50	35	72
Rome...............	56	46	76
Naples	1 1	58	81
Athens..............	18	2 53	97
Alexandria...........	40	3 40	109

The whole duration of the eclipse will, at all these places, be rather more than two hours and three quarters. But the *duration of the annulus* will not, in any place, exceed six minutes; and in some places (at the confines of the umbra) it will be momentary. The nearer the spectator happens to be to the centre of the path of the moon's umbra, the longer will the annular appearance continue.

(*To be continued.*)

Article V.

Researches on various Fatty Bodies, and particularly on their Combinations with Alkalies. By M. Chevreul.*

After noticing the imperfect state of our knowledge on the subject of saponification, and the mistaken ideas that have been entertained respecting it by preceding chemists, the author gives an account of a new compound, which he had discovered in examining the soap which is composed of hog's-lard and potash. When this soap is digested in a large quantity of water, a part of it is dissolved, while a portion, which is insoluble, is deposited in the form of small brilliant scales, which he calls *pearly matter* (matiere nacrée). These scales were purified by being repeatedly washed in cold water, and afterwards digested in alcohol, to remove from them the soluble soap and the various impurities which they contained; they were subjected to the action of diluted muriatic acid, by which they were decomposed, and a new animal principle was obtained, to which the name of *margarine* was applied, in consequence of its pearl-like aspect, and the property which it possesses of communicating the pearly lustre to the combinations which it forms with salifiable bases.

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* M. Chevreul has, for some years, been assiduously directing his attention to this subject, and has, from time to time, published an account of his experiments in a succession of papers inserted in the Annales de Chimie; the first of them appeared in the 88th volume of that work; they have been continued at intervals; and, as we learn from the number for April last, are not yet completed. We propose to give an abstract of the whole; but as the contents of the earlier of them may probably be known to many of our readers, we shall pass them over in a more brief manner.

The properties of margarine are then described; it is of a pearly-white colour, without taste, of a faint odour, a little like that of white wax, it is lighter than water, and at 134° * melts into a perfectly limpid colourless fluid, which, by cooling, crystallizes into brilliant white needles. By distillation, margarine is partially decomposed; it is insoluble in water, but is very soluble in alcohol when heated to 167°; as the alcohol cools, the margarine is precipitated, or if the solution has been saturated, the whole is converted into a solid mass.

The pearly matter, formed by the combination of margarine with potash, was next examined. All the potash being very carefully separated from it by means of diluted muriatic acid, and the quantity of muriate of potash thus formed being accurately ascertained, it was calculated to be composed of

Margarine	91·91	100·0
Potash	8·09	8·8
	100·00	

Cold water has no action on the pearly matter; but boiling water partially separates the potash from it. It is less soluble in alcohol than margarine; if water be added to the alcoholic solution, a precipitate is thrown down, which appears to contain a smaller proportion of potash than the pearly matter; it was found that about $\frac{1}{8}$ of the alkali was united to the water. If the substance which is separated from alcohol by water be twice dissolved in alcohol, it is deposited on cooling in its original state, composed of 100 parts of margarine to 8·88 parts of potash.

M. Chevreul was then induced to examine, whether, if margarine be presented to a heated solution of potash, containing a considerably larger proportion of alkali than was necessary to convert it into the pearly matter, a more alkaline compound would be formed. Upon making the trial, this was found to be the case; by digesting in water a quantity of potash and margarine, a white matter was formed, which was soluble in heated alcohol, and was deposited from it as it cooled in the form of small needles, which, when treated with muriatic acid, were found to be composed of 100 parts of margarine, and 17·77 parts of potash, or almost exactly double the proportion of potash in the pearly matter described above. This compound of margarine and potash is white, not so soft as the pearly matter, and slightly alkaline to the taste; it is decomposed by water, the pearly matter being reproduced and the additional quantity of potash separated. This decomposition, however, only takes place when the quantity of water employed is large; for if it be used in small quantity, the decomposition is only partial, and a thick transparent mucilage is formed. M. Chevreul regards this as a saturated compound of the two substances. Margarine decomposes the subcarbonate of potash, carbonic acid is disengaged, and the pearly matter is formed.

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* The degrees of temperature in this abstract are always measured by Fahrenheit's scale.

As it appears that margarine possesses some of the leading properties of acids, it becomes a question for consideration, how far it is entitled to the denomination of an acid. It is necessary, therefore, to determine what are the characters of acids; and M. Chevreul states the following as those which have been generally considered to be essential; the sour taste, their attraction to the positive galvanic pole, their neutralizing salifiable bases, and their effect upon vegetable colours. The value of these several characters, as indicative of acidity, is then discussed; it is stated that the sour taste is not found in all acids, that the attraction for the positive pole is not confined to acids, and that the same is the case with the neutralization of alkalies; with respect to the effect of acids upon vegetable colours, that the reddening of litmus has been generally regarded as the most characteristic property, and that no body which is considered as an acid is destitute of it. Upon the whole, the properties of margarine are such as have generally been supposed to entitle a body to the denomination of an acid; for it not only reddens litmus, but it separates potash from carbonic acid, and forms combinations that are, in all respects, analogous to neutral salts. Its composition may, perhaps, appear an objection to this decision; but it is now generally admitted by the modern chemists, that, in the classification of bodies, analogy of properties is to be considered more than composition.

M. Chevreul's Second Memoir.[*]

In the former paper, the author had examined the nature of one of the compounds resulting from the union of hog's-lard and potash, which he found to consist of the alkali and margarine. He now proposes to examine the other compound, which differs from the former in the obvious and essential circumstance of being soluble in cold water.

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[*] Abstracted from Ann. de Chim. xciv. 80.

M. Chevreul began by carefully purifying the fat, and afterwards digested 250 parts of it with 150 of potash for two days, at a temperature of about 175°, by which the fat was completely dissolved; the compound became opaque, and a yellowish fluid spontaneously separated from it, the nature of which was examined. It was found to consist of the carbonate of potash, with a great excess of base, arising from too large a proportion of potash having been added to the fat, a little acetic acid, an aromatic principle, and *the sweet principle of oils*. The soap itself was next examined: it was completely dissolved by boiling water; but as the fluid cooled, a large quantity of the *pearly matter* separated, and it required 10 successive operations, performed at an interval of several days, to remove all this matter from it. The solution of the pure soap was decomposed while hot by pure tartaric acid; the fat appeared in the form of white masses, which melted into a yellowish oil. The fluid which contained the acidulous tartarate of potash was poured off and distilled, and a quantity of acetic acid, of the aromatic principle, and a little of the sweet principle, were procured. The fat, which had been separated from the potash by the tartaric acid, was of a yellow colour, melted at about 60°; its weight compared to that of the fat originally employed was as 120 to 250. These 120 parts were melted, and added to 72 parts of potash, dissolved in 480 parts of water, at the temperature of 86°. When the soap thus formed was added to cold water, a very small quantity only of the pearly matter was precipitated; but this was found, by repeating the experiment with a smaller quantity of potash, to depend upon an excess of alkali preventing the separation of the pearly matter; for under these circumstances, a portion of it was still deposited. When by this means the pearly matter was completely separated, the fat was obtained nearly in a fluid state, and was then found to possess the following properties. It had a rancid odour and taste; at the temperature of 66° its specific gravity is ·898; at about 43° it concretes into white needles; while it remains fluid it possesses a light yellow colour, similar to that of olive oil. Suspecting that this yellow colour, as well as that of other oils and resins, depended upon a matter extraneous to it, M. Chevreul endeavoured to separate it by boiling the *fluid fat* with carbonate of barytes, in the proportion of two parts of the latter to one of the former, mixed with a quantity of water. The result of this operation is the disengagement of carbonic acid, and the combination of the fluid fat with the barytes, so as to form a yellow, viscid, saponaceous mass.

By separating the water, evaporating it, and treating the solid residue with alcohol, a quantity of yellow colouring matter is procured, while the soap of barytes was left pure and colourless.

The next object was to ascertain the composition of this soap: for this purpose a portion of it was put into a platina crucible, which was then gradually raised to a red heat, by which a quantity of carbonate of barytes was obtained, combined with a minute portion of carbon; sulphuric acid was added, and by comparing the quantity of sulphate of barytes formed with the soap employed, he determined the composition to be,

Fluid fat	77·55	100·00
Barytes	22·45	28·95
	100·00	

By decomposing this barytic soap with sulphuric acid, the fluid fat is separated in a very pure state, and was supposed, like the pure margarine, to possess the power of reddening litmus.

The *fluid fat* seems to be capable of forming two combinations with potash; the first, with a minimum of alkali, which is gelatinous, soluble in alcohol, but insoluble in water; the other is soluble in water, but appears to be decomposed into potash and into the other species of soap, when it is diffused through a large quantity of fluid. Water appears to exercise the same kind of action upon the soap of the fluid fat as upon that of margarine; that is, it reduces it to potash and the super-soap; a greater quantity of fluid and a longer space of time are, however, necessary to complete the operation. The experiments which were performed in order to investigate all these points require a very long space of time for their completion, some of them as much as 18 months, and they are among the most elaborate in the whole science of chemistry. The general conclusions which the author deduces from his experiments are, that the soap formed by the union of lard and potash is not a mere binary compound, but is composed of margarine, fluid fat, a volatile oil, and an orange-coloured matter. These bodies are saturated with potash; the first two exist in a much greater proportion than the last two, and may be regarded as the essential constituents of soap. The experiments which have been related above, and the conclusions to which they lead, enable us to explain the manner in which soap acts when it removes grease from stuffs. It in fact depends upon a portion of the alkali being set at liberty, and thus being enabled to act upon fatty substances, in consequence of the decomposition of the soap of margarine by the addition of water. The same decomposition may be effected in the soap of the fluid fat, provided it be diluted with a sufficient quantity of water; but probably the principal operation of this substance is to yield to the fatty matters a portion of its alkali, so as to form them into a supersoap, while it is itself reduced to the same state.

M. Chevreul's Third Memoir.[*]

The object of this memoir is to ascertain whether the bodies which are found after the process of saponification are the essential products of that process, or if they previously existed in the fat, and in this way to become acquainted with the theory of saponification and with the composition of fat. M. Chevreul first inquires whether the acetic and carbonic acids, which are found in certain stages of the operation, are essential to it; and the result of his inquiry is, that they are not so, but that they depend upon some impurity in the substances employed. He next inquires whether oxygen gas be necessary to saponification; and by forming a portion of soap in a situation where it was deprived of all contact with the air, he found that it was not necessary for the union of the fat and the potash, nor for the separation of the pearly matter, provided the soap be diffused through a sufficient quantity of water.

The next topic is respecting the change which the fat experiences during saponification; and in order to ascertain this point, M. Chevreul enters into a detailed examination of the nature and properties of fat before and after it has undergone this process. The differences were found to be considerable: besides a change in colour and consistence, the melting point is different, being 78·5° for the fat in its natural state, and 103° after saponification; in the former state it is nearly insoluble in alcohol, and does not redden litmus, while in the latter state it is extremely soluble in alcohol, and powerfully affects the colour of litmus. We must, therefore, conclude, either that the fat has experienced a considerable alteration by the action of the potash, or that it originally consists of margarine, *fluid fat*, together with a colouring, an odoriferous, and a sweet principle; and that these bodies have so strong an affinity for each other as to conceal their specific properties; it is, however, very difficult to conceive how this could be the case, when we consider the nature of the difference which there is between the two bodies. In order to throw further light upon this point, M. Chevreul proceeds to investigate whether fat ought to be considered as a *simple proximate principle.* By dissolving the fat in a large quantity of alcohol, and observing the manner in which its different portions were acted upon by this substance, and again separated from it, it is concluded that fat is composed of an *oily substance,* which remains fluid at the ordinary temperature of the atmosphere; and of another *fatty substance* which is much less fusible. Hence it follows that fat is not to be regarded as a simple principle, but as a combination of the above two principles, which may be separated without alteration. One of these substances melts at about 45°, the other at 100°; the same quantity of alcohol which dissolves 3·2 parts of the *oily substance* dissolves 1·8 only of the *fatty substance;* the first is separated from the alcohol in the form of an oil, the second in that of small silky needles. We perceive that the above substances differ as much from margarine and *fluid fat* as natural fat differs from that which has been saponified.

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[*] Abstracted from Ann. de Chim. xciv. 113.

Each of the constituents of natural fat was then saponified by the addition of potash; and an accurate description is given of the compounds which were formed, and of the proportions of their constituents. The *oily substance* became saponified more readily than the *fatty substance;* the residual fluids in both cases contained the sweet oily principle; but the quantity that proceeded from the soap formed of the *oily substance* was four or five times as much as that from the *fatty substance;* the latter soap was found to contain a much greater proportion of the *pearly matter* than the former, in the proportion of 7·5 to 2·9; the proportion of the *fluid fat* was the reverse, a greater quantity of this being found in the soap formed from the oily substance of the fat.

When the principles which constitute fat unite with potash, it is probable that they experience a change in the proportion of their elements; this change developes at least three bodies, *margarine, fluid fat,* and *the sweet principle;* and it is remarkable that it takes place without the absorption of any foreign substance, or the disengagement of any of the elements which are separated from each other. As this change is effected by the intermedium of the alkali, we may conclude that the newly formed principles must have a strong affinity for salifiable bases, and will in many respects resemble the acids; and, in fact, they exhibit the leading characters of acids in reddening litmus, in decomposing the alkaline carbonates to unite to their bases, and in neutralizing the specific properties of the alkalies.

M. Chevreul's Fourth Memoir.[*]

The subject of M. Chevreul's fourth paper is the action of certain salifiable bases upon hog's-lard, and the capacities for saturation of margarine and fluid fat. Having already pointed out the analogy between the properties of acids and the principles into which fat is converted by means of the alkalies, the next object was to examine the action which other bases have upon fat, and to observe the effect of water, and of the cohesive force of the bases upon the process of saponification. The substances which the author subjected to experiment were soda, the four alkaline earths, alumine, and the oxides of zinc, copper, and lead. After giving a detail of the processes which he employed with these substances respectively, he draws the following general conclusions. Soda, barytes, strontian, lime, the oxide of zinc, and the protoxide of lead, convert fat into *margarine, fluid fat, the sweet principle, the yellow colouring principle,* and *the odorous principle,* precisely in the same manner as potash. Whatever be the base that has been employed, the products of saponification always exist in the same relative proportion. As the above-mentioned bases form with margarine and the fluid fat compounds which are insoluble in water, it follows that the action of this liquid, as a solvent of soap, is not essential to the process of saponification. It is remarkable that the oxides of zinc and of lead, which are insoluble in water, and which produce compounds equally insoluble, should give the same results with potash and soda, a circumstance which proves that those oxides have a strong alkaline power. Although the analogy of magnesia to the alkalies is, in other respects, so striking, yet we find that it cannot convert fat into soap under the same circumstances with the oxides of zinc and lead. But although magnesia does not saponify fat, it forms with it an homogenous substance, from which the fat does not separate even when placed in boiling water, notwithstanding the difference in the specific gravity of the ingredients. Alumine that has been mixed with fat is entirely separated from it by this means. Hence we may establish three gradations in the action of salifiable bases on fat, that in which a perfect saponification is produced, as is the case with the alkalies, where there is a union but not a proper saponification, as with magnesia, and where there appears to be no union, as in the case of alumine.

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[*] Abstracted from Ann. de Chim. xciv. 225.

The author next proceeds to examine the quantity of fat which a given weight of potash can saponify, in order to form a standard of comparison for the other saponaceous compounds, when it was found that 100 parts of hog's-lard were reduced to the completely saponified state by 16·36 parts of potash. He now enters upon the consideration of the different soaps that are capable of being formed by the margarine and the fluid fat respectively, and endeavours to estimate the proportions of which they consist. The soap composed of margarine and potash, as has been stated above, exists in two proportions, the saturated compound, consisting of 100 parts of margarine to 17·77 of potash; the other, or the super-margarate, consisting of 100 parts of margarine to only half the former quantity of potash, 8·8 parts. It is observed that in the first of these combinations the margarine saturates a quantity of base, which contains three parts of oxygen, proceeding upon the estimate that 100 parts of potash contain 17 of oxygen. M. Chevreul then prepared soaps composed of margarine and soda, margarine and barytes, margarine and strontian, and margarine and lime; by decomposing them *by an acid,* and finding the quantity of neutral or earthy salt that was thus formed, he was able to estimate the quantity of base that had been united with the margarine in each of the compounds. These were found to be as follows:

Margarine	100·00
Soda	12·72
Margarine	100·00
Barytes	28·93
Margarine	100·00
Strontian	20·23
Margarine	100·00
Lime	11·06

By calculating the amount of oxygen contained in these different bases, it appears that in these compounds, as well as in that of magarine and potash, the margarine unites to about three per cent. of oxygen. By boiling margarine with the subacetate of lead, a compound was formed of margarine and the protoxide of lead, which consisted of 100 parts of margarine to 83·78 parts of the protoxide of lead; but as this would contain nearly six per cent. of oxygen, it was supposed to be a sub-soap, or one with an under proportion of base. By boiling together the saturated solutions of nitrate of lead and soap of potash, a neutral compound of margarine and oxide of lead was procured, composed of margarine 100 parts, and 41·73 parts of oxide of lead; the oxygen in this quantity of oxide of lead is 2·98.

M. Chevreul next proceeds to examine the compounds formed by the union of the *fluid fat* with the different bases. It was found more difficult to ascertain the composition of these soaps than of the soaps of margarine, because it was less easy to procure the fluid fat in a uniform state, always exhibiting the same properties; under one form in which it was procured it remained fluid almost to the freezing point of water, while another specimen congealed at 43°. The soap of the fluid fat and barytes was found to consist of fluid fat 100 parts, and barytes about 27 parts, which will give 2·83 per cent. of oxygen in the compound. The soap of fluid fat and strontian consists of 100 parts of the fluid fat to 19·38 of strontian, containing 2·81 parts of oxygen; and the soap of the fluid fat and the protoxide of lead may be estimated at about 100 parts of the fluid fat to 114·81 of the oxide of lead. There was some difficulty in estimating the composition of the soap of the fluid fat and potash, in consequence of the tendency which these bodies have to form a super-soap as well as a neutral soap; but by a careful, synthetical experiment, the author ascertained the proportion of the constituents to be 100 parts of the fluid fat to 16·58 of the base; this quantity of base contains 2·82 parts of potash. The soap of the fluid fat and soda consists of 10·11 parts of alkali to 100 parts of fat. M. Chevreul then states the composition of some of the other saponaceous compounds formed by the *fluid fat*;

with lime it combines in the proportion of 100 parts to 9·64; with magnesia, 7·52; with oxide of zinc, 14·83; with peroxide of copper, 13·93; the soap of copper was of a green colour; as was also the case with the soap composed of the black peroxide of copper and margarine. Soaps were also formed of the fluid fat with the oxide of cobalt, which was of a bluish green colour; with the oxide of nickel, of a yellowish green; and with oxide of chrome, which was of a violet colour: in these last cases the exact proportions in which the substances combine were not ascertained. The above experiments establish in a decided manner the strong analogy which exists between margarine and the fluid fat and acids; they have, like these bodies, determined capacities for saturation, while their combinations with salifiable bases may be regarded as forming a distinct class of salts. The art of making soap consists, therefore, in converting fatty bodies into oily acids by means of alkalies; and in forming these acids into compounds subjected to definite proportions.

*M. Chevreul's Fifth Memoir.**

The subject of this memoir is adipocire; by which is meant the crystallized substance that enters into the composition of human, biliary calculi, spermaceti, and the peculiar matter obtained from dead bodies. The term adipocire was introduced by Fourcroy, and was applied by him to the three substances mentioned above, which he conceived to be varieties only of the same primary compound; and in the latter case, as obtained from the muscular parts of animals that had experienced a peculiar change in the earth to be converted into the state of a soap by the addition of ammonia. These opinions of Fourcroy, however, M. Chevreul supposes to be erroneous. He begins by examining the crystallized matter of human, biliary calculi; the properties of this substance are described; it melts at about 278°, and crystallizes by cooling into radiated plates; it appeared to be only partially decomposed by distillation; it is readily dissolved by boiling alcohol, but it seemed to be incapable of forming a soap with potash.

The properties of spermaceti are next examined; it melts at about 112°; it is not much altered by distillation; it dissolves readily in alcohol, but separates as the fluid cools; the solution has no effect in changing the colour of the tincture of litmus, a circumstance, as it is observed, in which it differs from margarine, a substance which, in many respects, it resembles. Spermaceti is capable of being saponified by potash, with nearly the same phenomena as when we submit hog's-lard to the action of potash, although the operation is effected with more difficulty,

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* Abstracted from Ann. de Chim. xcv. 1.

For the purpose of analyzing the soap, it was added to a large quantity of water, and kept at the temperature of 212°; it was not dissolved; but the fluid, as it cooled, deposited a large quantity of opaque flakes. A portion was kept suspended, which had a brilliant and pearl-like appearance; this was collected, and dissolved in boiling alcohol, from which it was in part deposited by the cooling of the fluid: this was the proper soap formed of spermaceti and potash. This soap, after being properly purified, was decomposed by muriatic acid, when it was found to be composed of a peculiar fatty substance, to which M. Chevreul gives the name of *saponified spermaceti* and potash, in the following proportions:

Saponified spermaceti. ..	92·462	100·00
Potash	7·538	8·15

The soap of spermaceti is white, and is without taste. Alcohol, which has been saturated with it at the boiling heat, concretes into a mass as it cools; the solution slightly reddens hematine, but has no action upon litmus, in which respect it differs considerably from the super-soap of margarine. The soap of spermaceti is insoluble in water; but if it be boiled for a long time in this fluid, a quantity of the alkali is separated from it. The soap itself, by this process, appears to be decomposed into two compounds containing different proportions of potash; one, 5·48 parts of potash; and the other, four parts to 100 parts of the saponified spermaceti.

M. Chevreul then examined the properties of the *saponified spermaceti;* its melting point is the same with pure spermaceti, but it is more soluble in alcohol; the solution reddens litmus; and, as it cools, concretes into a crystalline mass; it is capable of being combined with an additional quantity of potash, so as to form a soap similar to that described above. The author next enters into a minute analysis of the substances which are connected with the saponified spermaceti in the process by which it is formed; he supposes them to be as follows: 1. Saponified spermaceti; 2. An oil which is fluid at the ordinary temperature of the atmosphere; 3. A concrete oily substance; 4. A yellow matter; and, 5. A volatile oil: but it is admitted that the last four bodies exist in so small quantity as to render it difficult to ascertain their properties with accuracy. It is supposed that the third substance is a combination of the first two; and that it is particularly to the second that it owes its property of being soluble in potash. M. Chevreul remarks that the air may have had some effect upon these substances, particularly upon the fourth and fifth; for that the experiments occupied more than six months, during which time they were continually exposed to the air. Saponified spermaceti is very analogous to margarine; but this substance is sufficiently distinct from spermaceti both in its pure and in its saponified state. They differ materially in their boiling point, in their solubility in alcohol, and in their capacity of saturation with potash.

We next proceed to the third part of the memoir, an account of the fatty matter occasionally formed in dead bodies. We have an examination of the substances which are united to the fatty matter, and afterwards an analysis of the fatty matter itself. The fatty matter was first acted upon by alcohol, and afterwards the residue, insoluble in alcohol, was boiled with water. The water removed small portions of lactic acid, lactate of lime, lactate of potash, a yellow colouring matter, and an azotated matter. The substance which was insoluble in water was then treated with muriatic acid, and the fluid was saturated with ammonia, when phosphate of lime and magnesia, and oxide of iron were deposited: by the addition of carbonate of ammonia, carbonate of lime was deposited. The part which was insoluble in muriatic acid was again treated with boiling alcohol, by which nearly the whole of it was now dissolved, except a small quantity of an azotated matter and some extraneous substances.

That part of the fatty matter which had been deposited from boiling alcohol was then examined; it melted at 175°; by prolonging the fusion, ammonia was disengaged, and the substance was rendered more fusible. The substance was decomposed by muriatic acid; and from the result of the process, we learn that it consisted of a peculiar fatty matter, to be afterwards more particularly examined, ammonia, potash, and a minute quantity of lime which were combined with it. The alcohol itself was then examined, when by gradually evaporating it, two distinct substances were separated from it, which differed a little in their melting point and other properties, chemical and physical. A portion of ammonia, together with lactic acid and some other substances in small quantities, were detected in the fluid. The author's general conclusion respecting the fatty matter of dead bodies is that, even after the lactic acid, the lactates, and other ingredients which are less essential, are removed from it, it is not a simple, ammoniacal soap, but a combination of various fatty substances with ammonia, potash, and lime. The fatty substances which were separated from alcohol, as has been remarked above, had different melting points and different sensible properties. It follows from M. Chevreul's experiments, that the substance which is the least fusible has more affinity for bases than those which are more so. It is observed that adipocire possesses the characters of a saponified fat; it is soluble in boiling alcohol in all proportions, reddens litmus, and unites readily to potash, not only without losing its weight, but without having its fusibility or other properties changed.

As adipocire appears to exist in different states, or as the same term has been applied to substances possessed of different properties, the author examined the action of potash upon different varieties of it, and first upon adipocire that is fusible at 113°. He saponified 60 parts of this adipocire by half its weight of potash dissolved in water; the soap that was formed was soft and opaque; a mother-water was left of an orange colour. The soap was diluted with cold water, when 40 parts of the pearl-like matter were extracted from it; what remained in solution being decomposed by tartaric acid, 16 parts of a reddish matter were procured, and 1·5 of a white, flocculent matter. The mother-water was then examined; by distillation a quantity of ammoniac and an oily matter were obtained, and by using different re-agents, an odorous principle, and a bitter, yellow matter were also procured; by analyzing the pearly matter of the soap of adipocire, this body was found to consist of margarine, of a fatty matter which is fluid at 44·5°, of a yellow, colouring principle, and of an odoriferous principle. An adipocire which is fusible at 129° was then subjected to the same series of operations with the preceding, when it was found to contain the same principles, but in different proportions; it differed especially in containing more margarine than the former.

The author then compares the margarine of the fatty matter from dead bodies with that from the soap of hog's-lard. They are both soluble in the same proportions in boiling alcohol; the solutions both of them redden litmus, and deposit brilliant crystals as they cool. They are similarly affected by heat, they combine with potash in the same proportions, and they form soaps which exhibit very nearly the same properties. The points in which they differ are their fusibility, and the form which they assume when they pass from the fluid to the solid state; but these differences are not considerable, and, perhaps, are not sufficient to induce us to regard the substances as essentially dissimilar.

In his third memoir, M. Chevreul has shown, that hog's-lard, in its natural state, has not the property of combining with alkalies; but that it acquires it by experiencing some change in the proportion of its elements. This change being induced by the action of the alkali, it follows that the bodies of the new formation must have a decided affinity for the species of body which has determined it. If we apply this foundation of the theory of saponification to the change into fat, which bodies buried in the earth experience, we shall find that it explains the process in a very satisfactory manner. In reality, the fatty matter is the combination of the two adipose substances with ammonia, lime, and potash; one of these substances has the same sensible properties with margarine procured from the soap of hog's-lard; the other, the orange-coloured oil, excepting its colour, appears to have a strong analogy with the fluid fat. From these circumstances it is probable that the formation of the fatty matter may be the result of a proper saponification produced amonia, proceeding from the decomposition of the muscle, and by the potash and lime, which proceed from the decomposition of certain salts. Two suggestions are offered by the author, which seem to result from his conclusions, although they are in opposition to the opinions generally received on this subject, and which he proposes to make the subject of a future memoir. He asks, 'whether fat is not the only animal matter which is capable of being converted into the peculiar adipose matter, and not the muscular fibre? and must not this change be effected by alkalies, and not, as is generally supposed, by nitric acid?

The author concludes by giving a summary view of the differences between the three bodies which have obtained the name of adipocire. The biliary calculus and spermaceti may be considered as immediate simple principles, since we have not been able to separate any bodies from them, without changing their nature. But this is not the case with adipocire, properly so called, as this certainly results from the action of two fatty bodies, one of which has the greatest analogy with margarine, while the other is very similar to the fluid fat. Biliary calculus requires for its fusion a temperature of 278°, whilst spermaceti melts at 112°. The fatty matter from dead bodies melts at different temperatures, from 111° to 129°, according to the proportions of the substances that enter into its composition. One hundred parts of boiling alcohol dissolve 18 parts of biliary calculus, and 6·9 parts of spermaceti: adipocire appears to dissolve in it in an indefinite quantity.

Potash boiled during 15 days with biliary calculus in the proportion of five to one does not saponify it. The same alkali boiled with spermaceti during five days in the proportion of 18 to 30 entirely saponifies it. A substance is then produced analogous to margarine, but which differs from it so decidedly in some respects, that they may be considered as forming two distinct species. If the difficulty of saponifying biliary calculus does not depend entirely upon its force of cohesion; if, for example, we should prove that it cannot be effected by exposing it in a digester to a temperature of above 280°, we must conclude that the proportion of the elements of biliary calculus does not admit of its being reduced into the state of a body which has a great affinity for alkalies. The difficulty which there is in saponifying spermaceti shows that the elements of it are not in the same relation as those of fat; and what proves the same thing is, that spermaceti does not produce the sweet principle of oils, as is the case with fat.

(To be continued.)

Article VI.

On a Mass of Platinum at Madrid. By Henry Heuland, Esq.

(To Dr. Bostock.)

Dear Sir, *25, King-street, St. James's, July 22,* 1818.

I beg to wait upon you with the extract from an authentic communication, with which I have been favoured, respecting the mass of platina now deposited in the Royal Museum at Madrid. Dn. Ignaico Hurtado is the proprietor of certain lands in the Quebrada* de Apotó, in the province of Notiva, in the government of Chocó. In this Quebrada is situated his gold mine, called Condoto. One of his negro slaves, named Justo, found this mass of platina in the year 1814, near the gold mine. Dn. Ignaico, most generously, and full of ardour for the sciences, presented this unequalled specimen to His Most Catholic Majesty, through his Excellency Sor. Dn. Pablo Morillo, Commander-in-Chief of the Royal Spanish armies in the province of Venezuela, who transmitted the same, together with other objects of natural history, belonging to the botanical department, under the Spanish naturalist Dn. José Mutis, to Europe through General Pascual Enrile, who brought it safely to Spain, and forwarded it to the hands of the King himself by Captain Antonio Van Halen. Being an unique specimen, his Majesty gave it to the Museum. Its figure is oval, and inclining to convex. The Spaniards term it "*Pepita,*" which signifies water worn, and not *in sitú.*

Its larger diameter is two inches, four lines and a half; and its smaller diameter two inches. Its height is four inches and four lines. Its weight is one pound, nine ounces, and one drachm. Its colour is that of native silver. Its surface is rough, and here and there spotted with yellow iron ochre. The negro who found it suspected that it contained gold: he tried to fracture it, but he was only able to make a dent in the metal, which is, however, sufficient to show its character.

I have to note the very important discovery of two mines of precious opal in the kingdom of Mexico; they are in the district of Gracias de Dios, 60 Spanish miles in the interior of the province of Honduras, or Comayagua, in the kingdom of Guatimala. These opals are imbedded in porcelain earth, and are accompanied by all the other varieties of opal, but particularly by the beautiful sky blue girasol, and by the sun opal of Sonnenschmidt, who discovered the latter at Guadalupe at a league's distance from Mexico, the capital of that name. The gentleman through whom I procured these opals, presented to me a very interesting meteorite, not yet described in any work; it is from the coast of Omoa, in the province of Honduras, at 10 leagues' distance from the sea, and was found on a hill which abounds with this iron. The history of its fall and dates are unknown.

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* Quebrada signifies a country broken into, or intersected with ravines and clefts.

To avoid every possible doubt about the mass of platina, I should, perhaps, have mentioned, that the Spanish Secretary of State, his Excellency Dn. José García de Leon and Pizarro, had taken all the measures to ascertain the fact of its being genuine, native platina.

I have the honour to be, dear Sir,
Your most obedient and humble servant,
HENRY HEULAND.

ARTICLE VII.

Analysis of Barley. By M. Proust.

BARLEY has been made the subject of an elaborate chemical analysis by MM. Fourcroy and Vauquelin, and by M. Einhof, who each of them published his remarks upon it about the same period. The latter of these chemists found ripe barley to contain starch, sugar, mucilage, gluten, albumen, a minute quantity of phosphate of lime, and a considerable proportion of a volatile matter, the nature of which appears to be not very accurately ascertained, besides the woody fibres which enter into the composition of the husk. To these constituents Fourcroy and Vauquelin have added a peculiar species of oil, which was procured by macerating the barley meal in alcohol; the fluid, by this process, becomes muddy, acquires a yellow colour, and deposits the oil by evaporation. They also detected in barley minute portions of some earthy neutral salts, and of iron, which were not mentioned by Einhof. This substance has been also examined by M. Proust, and his account of it differs considerably from that of his predecessors: it would appear from his statement that his experiments were principally performed some years since, even anterior to those referred to above, although they were only published during the last summer.*

Alcohol extracts from barley a yellow resin, which, when dry, has a pitchy consistence, and is not soluble in water. It exists likewise both in wheat and in maize, and is found in them all in the proportion of about $\frac{1}{100}$ of their weight; it is not destroyed by the process of germination. When barley meal is washed with cold water, we procure a yellow saccharine extract which is readily decomposed by alcohol; it seems to consist of gum, sugar, and gluten, in the proportions of ·04, ·05, and ·03 respectively. The author remarks, that these sums, making in the whole ·12, are exactly the quantity of loss which M. Sage found wheat to experience by being treated with cold water.

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* Ann. de Chim. et Phys. v. 337. (Aug. 1817.)

But besides these products, M. Proust informs us that he has discovered in barley a large quantity of a new principle, which had hitherto been confounded with starch, and which is procured by washing the meal in the same manner as when we wish to obtain gluten; but instead of this substance, we perceive on the fingers a rough, gritty matter, which is the body in question. M. Proust gives it the name of *hordeïne*.

This hordeïne, or hordeïn, is not soluble in water, and may be separated from the starch by boiling; it will then be left in the form of a yellow, granulated powder, which, he says, from its appearance, might be taken for sawdust. The following are the comparative analyses of wheat and barley.

Wheat.

Yellow resin	1·0
Gummy and saccharine extract	12·0
Gluten	12·5
Starch	74·5
	100·0

Barley.

Yellow resin	1
Gummy and saccharine extract	9
Gluten	3
Starch	32
Hordeïn	55
	100

To the large quantity of this substance, which is of so hard a texture, and is probably less nutritive than the other vegetable principles, M. Proust attributes the greater heaviness of barley bread and its inferior powers of nutrition.

With respect to the nature of this principle, we are informed that it resembles the woody fibrous bodies that contain no azote. By distillation, we obtain $\frac{1}{5}$ of its weight of a carbonaceous residue, also vinegar, oil, and gas, but no ammonia.

When barley germinates, it loses nearly $\frac{1}{5}$ of its weight, and also has its chemical composition, or the nature of its constituents, very much changed. The following is the comparative state of the substance before and after it has undergone this operation.

Barley that has not germinated consists of

Yellow resin	1
Gum	4
Sugar	5
Gluten	3
Starch	32
Hordeïn	55
	100

After germination it consists of

Resin	1
Gum	15
Sugar	15
Gluten	1
Starch	56
Hordeïn	12
	100

By comparing these two analyses, we perceive that some very remarkable changes have taken place. The gum is increased in quantity from ·04 to ·14 or ·15; the sugar is increased nearly in the same proportion, from ·05 to ·14 or ·15; the gluten is diminished, but the most remarkable alteration is in the quantity and relative proportion of the starch and hordeïn, the former of which is much increased in quantity, while the latter is still more remarkably diminished. M. Proust remarks that this production of starch in the process of germination, is a very singular and unexpected result, and, perhaps, even directly contrary to what might have been expected. It had been generally supposed that the gummy and saccharine matter is increased by germination in barley, as in the other cerealia; but the same thing had not been supposed to take place with respect to starch; and the author appears to be fully aware that a fact of so much importance should not be admitted until it is substantiated by the most unequivocal evidence.

That germination has a remarkable effect upon starch, M. Proust conceives that he has proved by the following experiments: To four ounces of boiling water he added two drachms of barley meal, which had been well washed with cold water in order to remove from it any gummy, saccharine, or other soluble matter. In this way we obtain an opaque, pasty substance, which cannot be distinguished from that formed with wheat. If we now repeat the process, but employ barley that has germinated, instead of the paste, we shall obtain a solution which is transparent as long as it remains warm, but which becomes opaque as it cools, and does not thicken or coagulate. From this comparative experiment it is inferred that starch actually acquires a degree of solubility by the process of germination, independent of the mixture of any gummy or saccharine matter with it.

With respect to the fermentation of barley, M. Proust observes that it differs very much from that of the grape; in the latter, the formation of alcohol is the primary effect, and that of the generation of carbonic acid only a secondary operation, while the reverse takes place in the fermentation of barley. Fermentation expels from the fluid, by the motion which it produces, all the hordeïn, which is thus mixed with the yeast; this is what gives the yeast the granulated and gelatinous appearance which it exhibits when it has been sufficiently drained. It is entirely soluble in boiling water, and forms a viscid glue; from this a gelatinous powder gradually separates, which is a portion of hordeïn that had been mixed with it while in the fermenting vat. If washed yeast be preserved under water, the starch and the hordeïn each resumes its characteristic property and separates into distinct layers.

As the inference from his discovery of hordeïn, forming so large a proportion of the substance of barley, M. Proust recommends that before this grain is employed for food in any form, either for gruels of different kinds or for bread, it should be previously submitted to the process of germination.

Although this paper was published during the course of the last year, yet, as we remarked above, it may be inferred that the experiments of which it gives an account have been performed for a considerable length of time. The author does not refer to the papers of MM. Fourcroy and Vauquelin, or of M. Einhof, and yet it is difficult to suppose that he was unacquainted with their contents. Nor can we easily conceive how these chemists, in their analyses of barley, should have overlooked so important a constituent, if it has an actual existence. M. Proust's reputation as an experimentalist is, however, so considerable, that it appeared to us desirable to lay an abstract of his results before our readers, although the facts may be supposed to rest upon rather doubtful authority.

Article VIII.

On Lacroix's Differential and Integral Calculus. By James Adams, Esq.

(To the Editors of the *Annals of Philosophy.*)

Gentlemen, *Stonehouse, April* 26, 1818.

The following formula, denoted by A, B, C, I have selected from pages 225 and 226 of the translation of "Lacroix's Differential and Integral Calculus," to which I have added the formula marked E and F; and as by their application many fluents may be found with very little trouble, your printing them with the accompanying illustrations in the *Annals of Philosophy* will much oblige Your most obedient servant,

JAMES ADAMS.

Formula.

$$\int x^{m-1} d\,x\ (a + b\,x^n)^P =$$

$$\frac{x^{m-n}(a + b\,x^n)^{P+1} - a\,(m-n)\int x^{m-n-1}\,d\,x\,(a + b\,x\ )^P}{b\,(P\,n + m)} \ldots\ldots\text{A.}$$

$$\int x^{m-1} d\,x\ (a + b\,x^n)^P =$$

$$\frac{x^m\ (a + b\,x^n)^P + a\,n\,p\int x^{m-1}\,d\,x\,(a + b\,x^n)^{P-1}}{P\,n + m} \ldots\ldots\ldots\ldots\text{B.}$$

$$\int x^{m-1} d\,x\,(a + b\,x^n)^P =$$

$$\frac{x^m(a + b\,x^n)^{P+1} - b\,(m + n + p\,n)\int x^{m+n-1}\,d\,x\,(a + b\,x^n)^P}{a\,m} \ldots\text{C.}$$

$$\int x^{m-n-1} d\,x\,(a + b\,x^n)^{P+1} =$$

$$\frac{x^{m-n}\ (a + b\,x^n)^{P+1} - b\,n\,(P + 1)\int x^{m-1}\,d\,x\,(a + b\,x^n)^P}{m - n} \ldots\ldots\ldots\text{E}$$

$$\int x^{m-1} d\,x\,(a + b\,x^n)^{P-1} =$$

$$\frac{x^{m-1}(u + b\,x^n)^P\,(m - n)\int x^{m-n-1}\,d\,x\,(a + b\,x^n)^P}{n\,b\,p} \ldots\ldots\ldots\ldots\text{F.}$$

Illustration.

The following examples are taken from "Dealtry's Fluxions," chap. xxii. By a little attention it may easily be seen that the *first thirty, thirty-four, and thirty-sixth* fluents may be determined by formula A; the *thirty-first* and *thirty-fifth* by formula C; the *thirty-second* and *thirty-seventh* by formula E; the *thirty-third* by formula F; and the *thirty-eighth* by formula A and B. Some of the fluents in the succeeding section of the same chapter, and many others, may be determined by the preceding formula.

Fluent 4.—To find the fluent of $\frac{x^m\,d\,x}{x - a}$, where m is a whole positive number.

$$\int \frac{x^m\,d\,x}{x - a} = \int x^m\,d\,x\,(x - a)^{-1}$$

$$= \frac{x^m}{m} + \frac{a\int x^{m-1}\,d\,x}{x - a}$$

$$= \frac{x^m}{m} + \frac{a\,x^{m-1}}{m-1} + \frac{a^2\int x^{m-2}\,dx}{x-a}$$

$$= \frac{x^m}{m} + \frac{a\,x^{m-1}}{m-1} + \frac{a^2\,x^{m-2}}{m-2} + \frac{a^3\int x^{m-3}}{x-a}$$

&c.

By comparing with formula A, we write $m + 1$ for m, and make $a = -a$, $b = 1$, $n = 1$, and $P = -1$.

Fluent 9.—To find the fluent of $\frac{x^{rm-1}\,dx}{x^m - a^m}$, where r is a whole positive number.

$$\int \frac{x^{rm-1}\,dx}{x^m - a^m} = \int x^{rm-1}\,dx\,(x^m - a^m)^{-1}$$

$$= \frac{x^{(r-1)m}}{(r-1)m} + \frac{a^m\int x^{(r-1)m-1}\,dx}{x^m - a^m}$$

$$= \frac{x^{(r-1)m}}{(r-1)m} + \frac{a^m\,x^{(r-2)m}}{(r-2)\,m} + \frac{a^{2m}\int x^{(r-2)m}\quad dx}{x^m - a^m}$$

$$= \frac{x^{(r-1)m}}{(r-1)m} + \frac{a^m\,x^{(r-2)m}}{(r-2)\,m} + \frac{a^{2m}\,x^{(r-3)m}}{(r-3)\,m} + \frac{a^{3m}\int x^{(r-3)m-1}\,dx}{x^m - a^m}$$

&c.

By comparing with formula A, we write $r\,m$ for m, m for n, $-a^m$ for a, 1 for b, and -1 for p.

Fluent 10.—To find the fluent of $\frac{c\,y\,dy - r\,y^3\,dy}{c + b\,y^2}$.

$$\int \frac{c\,y\,dy - r\,y^3\,dy}{c + b\,y^2} = c\int \frac{y\,dy}{c + b\,y^2} - r\int y^3\,dy\,(c + b\,y^2)^{-1}$$

$$= c\int \frac{y\,dy}{c + b\,y^2} + \frac{rc}{b}\int \frac{y\,dy}{c + b\,y^2} - \frac{ry^2}{2b}$$

$$= \frac{bc + rc}{2b^2}\int \frac{2\,y\,dy}{y^2 + \frac{c}{b}} - \frac{ry^2}{2b}$$

$$= \frac{bc + rc}{2b^2}\,.\,\text{hyp. log.}\left(y^2 + \frac{c}{b}\right) - \frac{ry^2}{2b}$$

By making $m = 4$, $n = 2$, $a = c$, and $P = -1$; in formula A.

Fluent 13.—Required the fluent of $\frac{b\,x_2{}^{n-1}\,dx}{\sqrt{a + fx^n}}$.

$$\int \frac{b\,x^{2n-1}\,dx}{\sqrt{a + fx^n}} = b\int x^{2n-1}\,dx\,(a + fx^n)^{-\frac{1}{2}}$$

$$= \frac{2\,b\,x^n}{3\,nf}\,(a + fx^n)^{\frac{1}{2}} - \frac{2ab}{3f}\int x^{n-1}dx\,(a + fx^n)^{-\frac{1}{2}}$$

$$= \left(\frac{2\,b\,x^n}{3\,nf} - \frac{4\,a\,b}{3\,n\,f^2}\right)(a + fx^n)^{\frac{1}{2}}\,.$$

The same as Mr. Dealtry's when reduced; $m = n$, &c. in formula A.

Fluent 17.—Required the fluent of $\frac{x^3\,d\,x}{\sqrt{a^2 + x^2}}$.

This fluent being of the same form as fluent 13, it may be compared therewith; by making $2\,n - 1 = 3$, or $n = 2$, $a = a^2$, $b = 1$, and $f = 1$.

Then $\int \frac{x^3\,d\,x}{\sqrt{a^2 + x^2}} = \frac{x^2 - 2\,a^2}{3}(a^2 + x^2)^{\frac{1}{2}}$; the same as Mr. Dealtry's when reduced.

Fluent 20. (*Case* 4.)—Required the fluent of $\frac{x\,d\,x}{\sqrt{x - a}}$.

By comparing with fluent 13; we have $2\,n - 1 = 1$, or $n = 1$, $b = 1$, $f = 1$, and $a = -\,a$.

Then $\int \frac{x\,d\,x}{\sqrt{x - a}} = \frac{4\,a + 2\,x}{3}\sqrt{x - a}$; the same as Mr. Dealtry's when reduced.

Fluent 23. (*Case* 2.)—Given the fluent of $\frac{x\,d\,x}{\sqrt{2\,a\,x + x^2}}$; required the fluent of $\frac{x^2\,d\,x}{\sqrt{2\,a\,x + x^2}}$.

$$\int \frac{x^2\,d\,x}{\sqrt{2\,a\,x + x^2}} = \int x^2\,d\,x\,(2\,a\,x + x^2)^{-\frac{1}{2}}$$

$$= \int x^{\frac{3}{2}}\,d\,x\,(2\,a + x)^{-\frac{1}{2}}$$

$$= \frac{x\,x^{\frac{1}{2}}\,(2\,a + x)^{\frac{1}{2}} - 3\,a\int x^{\frac{1}{2}}\,d\,x\,(2\,a + x)^{-\frac{1}{2}}}{2}$$

$$= \frac{x\,(2\,a\,x + x^2)^{\frac{1}{2}}}{2} - \frac{3\,a}{2}\int \frac{x\,d\,x}{(2\,a\,x + x^2)^{\frac{1}{2}}}.$$

By comparing with formula A, $m = \frac{5}{2}$, $n = 1$, $a = 2\,a$, $b = 1$, and $P = -\,\frac{1}{2}$.

Fluent 28.—Given the fluent of $(a + c\,z^n)^m\,.\,d\,z^{n-1}\,d\,z$; to find the fluent of $(a + c\,x^n)^m\,.\,d\,z^{2n-1}\,d\,z$.

$$d\int z^{2n-1}\,d\,z\,(a + c\,z^n)^m$$

$$= \frac{d\,z^n\,(a + c\,z^n)^{m+1} - a\,n\int z^{n-1}\,d\,z\,(a + c\,z^n)^m}{c\,n\,(r + 2)}$$

$$= \frac{d\,z^n\,(a + c\,z^n)^{m+1}}{c\,n + (r + 2)} - \frac{a\,d}{c\,(r + 2)}\int z^{n-1}\,d\,z\,(a + c\,z^n)^m.$$

The same as Mr. Dealtry's, when L is put instead of $\frac{(a + c\,z^n)^m{}_{+1} \times d}{(m + 1)\,n\,c}$. In making the comparison for this fluent, $2\,n$ is written for m, c for b, and m for p.

Fluent 31.—Given the fluent of $z^{rn-1}\,d\,z\,(a + c\,z^n)^m$; to find the fluent of $z^{rn-n-1}\,d\,z\,(a + c\,z^n)^m$.

$$\int z^{rn-n-1}\,dz\,(a+cz^n)^m =$$

$$\frac{z^{rn-n}(a+cz^n)^{m+1}-(m+r)\,nc\int z^{rn-1}\,dz\,(a+cz_n)^m}{an\,(r-1)}$$

where $m = rn - n$, $P = m$, and $b = c$; in formula C.

Fluent 32.—Given the fluent of $z^{rn+n-1}\,dz\,(a+cz^n)^m$; to find the fluent of $z^{rn-1}\,dz\,(a+cz^n)^{m+1}$.

$$\int z^{rn-1}\,dz\,(a+cz^n)^{m+1} =$$

$$\frac{z^{rn}(a+cz^n)^{m+1}-cn\,(m+1)\int z^{rn+n-1}\,dz\,(a+cz^n)}{rn}.$$

This fluent belongs to formula E, where $m = rn + n$, $b = c$, and $P = m$.

Fluent 33.—Given the fluent of $z^{rn-n-1}\,dz\,(a+cz^n)^m$; to find the fluent of $z^{rn-1}\,dz\,(a+cz^n)^{m-1}$.

$$\int z^{rn-1}\,dz\,(a+cz^n)^{m-1} =$$

$$\frac{z^{rn-1}(a+cz^n)^m-(rn-n)\int z^{rn-n-1}\,dz\,(a+cz^n)^m}{mnc}$$

This fluent belongs to formula F; where $m = rn$, $b = c$, and $P = m$.

Fluent 38.—Given $\int z^r\,dz\,(a+cz^n)^m = G$

$$\text{Required} \int z^{r+n}\,dz\,(a+cz^n)^m = H$$

$$\int z^{r+2n}\,dz\,(a+cz^n)^m =$$

$$\int z^{r+3n}\,dz\,(a+cz^n)^m = K$$

&c.

This class belongs to formula A.

$$\text{And} \int z^r\,dz\,(a+cz^n)^{m+1} = L$$

$$\int z^r\,dz\,(a+cz^n)^{m+2} = M$$

$$\int z^r\,dz\,(a+cz^n)^{m+3} = N$$

&c.

This class belongs to formula B.

From whence

$$H = \frac{z^{r+1}(a+cz^n)^{m+1}-a\,(r+1).\ G}{c\,(mn+n+r+1)}$$

$$I = \frac{z^{r+n+1}(a+cz^n)^{m+1}-a(r+n+1).\ H}{c\,(mn+2n+r+1)}$$

$$K = \frac{z^{r+2n+1}(a + cz^n)^{m+1} - a(r + 2n + 1) . I}{c(mn + 3n + r + 1)}$$

&c.

e *r* is continually increased by *n*.

d

$$L = \frac{z^{r+1}(a + cz\ )^{m+1} + (m + 1)na . G}{mn + n + r + 1}$$

$$M = \frac{z^{r+1}(a + cz^n)^{m+2} + (m + 2)na . L}{mn + 2n + r + 1}$$

$$N = \frac{z^{r+1}(a + cz^n)^{m+3} + (m + 3)na . M}{mn + 3n + r + 1}$$

&c.

e *m* is continually increased by unity.

Article IX.

Account of the Weather at Bombay.

(To Arthur Aikin, Esq.)

DEAR SIR, *Foster-lane, May* 28, 1818.

e inclosed register of the weather at Byculla, Bombay, een transmitted to me by Mr. Benjamin Hoton of that nent. If you think it will be interesting to the readers of *nnals of Philosophy*, it is much at your service for that se.

Yours truly,

Richard Knight.

il Statement of the Observations on the Weather, made at Rooms of the Literary Society of Bombay from July, 6, to June, 1817.

.te.	Thermometer.			Barometer.		
	Mean.	Highest.	Lowest.	Mean.	Highest.	Lowest.
16.				nches.	Inches.	Inches.
....	80°	84°	77°	29·80	29·89	29·64
....	78¼	81½	76½	29·82	29·99	29·71
ber....	79¼	82½	75	29·905	30·04	29·79
r	83½	87	80	30·035	30·19	29·95
ber	82½	86½	78½	30·07	30·19	29·96
ber	79¾	83½	76	30·075	30·18	30·01
17.						
....	78¾	83	74	30·135	30·19	30·01
y.	76½	82	70	30·10	30·22	29·96
....	79	82½	75	30·065	30·19	30·01
....	83½	88½	80	29·99	30·12	29·94
....	85½	90	82	29·95	30·09	29·76
....	82¼	89	77	29·885	29·99	29·62

N. B. The temperature is taken at 10 a. m., 1 p. m., and 4 p. m., daily; consequently the register does not show the extreme of cold, nor the true mean, which is probably about 2° lower.

The pressure is taken at 10 a. m., and 4 p. m., daily, at the opening and closing of the rooms.

◆

A Register of the Quantity of Rain fallen at Byculla, Bombay, in the Months of June and July, 1817.

		Inches.			Inches.
June	1	—	July	1	0·09
	2	0·32		2	0·49
	3	—		3	0·05
	4	1·23		4	0·18
	5	6·46		5	0·27
	6	—		6	
	7	0·03		7	0·15
	8	0·11		8	2·09
	9	0·80		9	0·55
	10	1·20		10	2·06
	11	1·57		11	0·17
	12	0·20		12	3·80
	13	2·30		13	0·99
	14	1·03		14	1·34
	15	—		15	2·57
	16	0·16		16	3·00
	17	1·38		17	0·49
	18	5·12		18	0·35
	19	1·85		19	1·91
	20	0·54		20	0·20
	21	—		21	0·25
	22	1·38		22	0·08
	23	9·03		23	0·35
	24	7·23		24	0·43
	25	0·15		25	0·64
	26	0·73		26	0·61
	27	—		27	—
	28	0·32		28	0·42
	29	1·43		29	0·06
	30	1·15		30	0·13
	—	—		31	0·15
Total		45·72	Total		23·87

Rain in June	45·72
——— July	23·87
Total	69·59

The pluviameter is fixed about three feet from the ground in an open garden, and the time of observation is 7 a. m. daily.

The greatest quantity of rain in one day in June was on the 23d, viz. 9·3 inch. But on the 24th the rain was the heaviest, and is particularly worthy of remark. It commenced about 8 a. m., and discontinued about 5 p. m.; so that the 7·23 inch. of rain fell in nine hours. Greatest quantity in July, on the 12th, 3·80 inch.

August 1, 1817.

◆

Register of the Quantity of Rain fallen at Byculla, Bombay, in the Month of September, 1817.

		Inches.
Sept.	1	0·04
	2	—
	3	0·09
	4	0·18
	5	0·07
	6	0·02
	7	1·33
	8	0·33
	9	2·68
	10	0·32
	11	0·87
	12	1·50
	13	4·08
	14	0·91
	15	1·25
	16	2·40
	17	0·42
	18	0·40
	19	—
	20	1·09
	21	1·75
	22	1·58
	23	1·25
	24	0·05
	25	—
	26	—
	27	0·21
	28	0·55
	29	—
	30	1·50
Total		24·87

Total in June	45·72
—— July	23·87
—— August	9·34
—— Sept.	24·87
Total for the four months	103·80
Oct. 1	0·20
Total	104·00

Article X.

On New Improvements in the Manufacture of superfine Woollen Cloth. By Thomas Gill, Esq.

(To the Editors of the *Annals of Philosophy.*)

No. 11, Covent Garden Chambers,
August 14, 1818.

GENTLEMEN,

On a recent journey into Gloucestershire, through some of the clothing districts, I was so much gratified by the new improvements made in the important arts of shearing and dressing the superfine cloths manufactured from Saxon wool, that I cannot resist the desire of making them more generally known through your *Annals.*

The greatest improvement that has been made in the cropping of cloth, since the shears were caused to be worked by machinery, is one just completed by Messrs. Lewis and Davis, of Brimscombe, near Stroudwater, in which a revolving blade acting against a fixed or ledger blade makes from 1000 to 1500 cuts per minute, a rapidity hitherto unequalled, and with the still more important result, that the blades instead of losing their edges mutually sharpen each other by use, and pass over the cloth from list to list with a speed which is astonishing, and a delicacy of touch and evenness of cut unrivalled, and which indeed seems likely to effect an entire change in the slow process now in common use. Mr. Stephen Price, engineer of Stroud, has likewise made an improvement in shears on a similar principle, but has been prevented by indisposition from bringing it into use. Mr. Adey, of Uley, has also made a considerable improvement in the machine shears.

Owing to the wetness of the late seasons, teazles have become so rotten, scarce, and dear, that it has become an important object to find substitutes for them; and various attempts have accordingly been made, some of which seem likely nearly, if not entirely, to supersede the use of them.

Among these, several patents have been taken out for the employment of wire brushes, with delicate sharp pointed hooks, in gig mills in place of the teazles. The greatest improvement, however, and which even promises to be attended with very great advantage over the use of teazles, has been made by Mr. Thomas Mear, of Dursley, who has invented a delicate kind of elastic combs, made of brass, which can be readily substituted in place of the teazles without any change being requisite to be made in the machinery, and some of which have been constantly in wear for six months without the least appearance of injury in consequence thereof; whereas teazles, even of the best quality, require to be very frequently renewed.

Messrs. Lewis and Davis have likewise lately made a machine which, though more complicated and expensive than Mr. Mear's, seems likely to be attended with considerable advantages over the common gig mills. Mr. Stephen Price has also an improved gig mill.

I am glad to find that this old staple manufacture of our country is now in a prosperous state. The manufacturers say that they have sufficient orders for their cloths; and I noticed that several new works are erecting, and new water wheels and steam engines adding to those already in use.

I am surprised that this truly interesting and highly picturesque district, and particularly the vale of Stroudwater and the neighbourhoods of Dursley and Uley, have not more attracted the attention of the visitors to Cheltenham, it being very little out of the direct road to that celebrated Spa. The appearance of the houses and manufactories upon the steep sides of the hills, which seem to the observer in the valleys below to be almost as it were suspended in the air, many of them having scarcely any ground to stand upon, and indeed none but what has been made out of the solid rock, and no path to them but by zig-zag courses cut on the face of the steep ascents to them, is truly novel and surprising. The view from Uley Bury camp, an ancient work, upon a lofty eminence, over the vale of the Severn into South Wales, is truly grand; and, in short, the entire scenery of this beautiful and well-wooded country makes it well deserve to be more generally frequented by tourists.

I am, Gentlemen, your most obedient servant,

THOMAS GILL.

P. S. Having seen Mr. William Hardy since the publication of my paper, "*On English and Foreign Copper, Zinc, and Brass,*" in your last number of the *Annals*, he informs me that he had the *old Dutch brass* of which he made the wheels for the time-piece at the Royal Observatory at Greenwich, not of the Board of Longitude, but of a Mr. Frodsham; and paid him for it at the rate of *one guinea per pound!*—a proof of the very high estimation in which it is held by watchmakers.

The initials of the Christian names of Mr. Hawkins should have been *J. J. and not* T. T. as inserted by a mistake of the *printer in that paper.*

ARTICLE XI.

On the Triple Prussiate of Potash. By R. Porrett, Esq.

(To the Editors of the *Annals of Philosophy.*)

GENTLEMEN, *Tower, August* 13, 1818.

I WAS much gratified on reading in your last number a very curious and instructive paper by Dr. Thomson, containing his analysis of the salt usually (but very erroneously) termed triple prussiate of potash; and having compared this analysis with mine, published in the Philosophical Transactions for 1814, the differences between them appeared as follow:

	By my Analysis.	By Dr. Thomson's.
Water	13·00	13·00
Ferruginous acid	47·66	45·90
Potash	39·34	41·64

On observing these differences, my first opinion was that Dr. Thomson's analysis was the most correct; but when I perceived that his results did not accord with the atomic theory, I must confess that my faith in them was shaken. In order to remove or confirm my doubts, I had recourse to experiment.

I took 50 grs. of ferruretted chyazate of potash, and having dissolved them in about two drams of warm water, I added to the solution 70 grs. of crystallized tartaric acid, previously dissolved in about four drams of warm water; the mixed liquid, after having been left for a day, was poured off from the super-tartrate of potash which it had deposited. I washed the salt thus obtained with small portions of spirit of wine several times, and added these washings to the decanted fluid; this fluid afterwards deposited a minute quantity more of the super-tartrate, which I added to what I had before procured. After satisfying myself that the fluid contained no more super-tartrate, I dried what I had obtained at a steam heat; it then weighed 72·35 grs.

From Berzelius's analysis of super-tartrate of potash, it appears that 100 parts contain 24·8 of potash; therefore, these 72·35 grs. must contain 17·9 grs. of that alkali.

Thus it appears that 50 grs. of ferruretted chyazate of potash contain 17·9 grs. of potash; consequently 100 grs. must contain 35·8: then as Dr. Thomson agrees with me as to the quantity of water of crystallization being 13 grs. it follows that the quantity of ferruginous acid must be 51·2 grs. and that the weight of an atom of this acid must be 85·9, the weight of an atom of potash being 59·1.

By a repetition of my analysis of ferruretted chyazate of
nd that I had made a considerable mistake in the
er which it contains; its composition, instead of

being 16·59 water, 34·31 acid, and 49·10 barytes, I now find to be,

Water	11·0
Acid	41·5
Barytes	47·5
	100·0

If we reckon the weight of an atom of the acid from this analysis, we shall find it 84·7, approaching very nearly to the weight deduced from my analysis of the ferruretted chyazate of potash by tartaric acid.

So far then there is nothing in the nature of these salts irreconcileable with the atomic theory; but the principal difficulty yet remains, and is contained in the following question:

How is the chemical constitution of this acid to be reconciled with the weight for it, deduced from the analysis of the ferruretted chyazates?

In answer to which, I beg to propose the following explanation, which, although not yet fully confirmed by experiment, I have every reason to believe is the true one.

Ferruretted chyazic acid is not, in my opinion, a compound of prussic acid and iron, as Dr. Thomson imagines, but a compound of the elements of two atoms of prussic acid — an atom of azote, + an atom of iron, or in other words, it is composed of

4 atoms carbon = 30·16
1 atom azote = 17·54
1 atom iron = 34·50
2 atoms hydrogen = 2·64
84·84

Its weight will, therefore, be 84·84. Ferruretted chyazate of potash and ferruretted chyazate of barytes will each consist of an atom of acid, an atom of base, and two atoms of water; hence their true composition will be as follows:

Ferruretted chyazate of Potash.

Ferruretted chyazic acid	50·93	84·84	1 atom
Potash	35·48	59·10	1 atom
Water	13·59	22·64	2 atoms
	100·00	166·58	

Ferruretted chyazate of Barytes.

Ferruretted chyazic acid	41·49	84·84	1 atom
Barytes	47·44	97·00	1 atom
Water	11·07	22·64	2 atoms
	100·00	204·48	

On calculating from these data what should be the gaseous products from five grs. of ferruretted chyazate of potash when decomposed by ignited peroxide of copper, it will be found that there should be produced.

	Cubic Inches.
Carbonic acid	7·12
Azote	1·78
Total gas	8·90

But Dr. Thomson only obtained,

Carbonic acid	5·205
Azote	2·420
Total gas	7·625

I can only account for this difference by supposing that a little atmospheric air, previously contained in the apparatus and carried over with the produced gases, must have formed part of the 2·420 cubic inches of azote, and that some of the ferruretted chyazic acid (before the oxide of copper acquired a red heat) must have yielded some other product which escaped observation; possibly a little prussic acid, or cyanogen. If I am wrong in these suppositions, Dr. Thomson will, I dare say, excuse me for making them; he must be as well aware as I am how exceedingly difficult it is to obviate every source of error in experiments of this delicate nature.

It is a great satisfaction to me to find that Dr. Thomson has abandoned the opinion which he entertained, that the ferruretted chyazic acid contained no hydrogen, and was a compound of cyanogen and of iron only, an opinion which induced him to name it in his System of Chemistry the ferro-cyanic acid, and its salts ferro-cyanates. I was perfectly convinced from many circumstances that occurred during my first experiments that this opinion was erroneous, and should have combated it when it appeared in his System had I been fond of controversy, or been able to find time for carrying on such a course of experiments as would, perhaps, have been requisite to produce conviction in others; as it was I contented myself with expressing to my chemical friends my dissent from Dr. Thomson's opinions on this subject; and I can venture to assure him that whenever he makes experiments with the sulphuretted chyazic acid, he will be convinced that it also contains hydrogen, and that the names sulpho-cyanic acid and sulpho-cyanates are quite inappropriate; equally so are the names proposed by Dr. Henry, of ferro-prussic and sulphuretted prussic acids, as these names imply that the prussic acid is contained in these compounds, instead of being merely the result of a new play of affinities when they are decomposed.

I conclude this communication with acquainting you, for the information of your chemical readers, that I have discovered a method of obtaining the ferruretted chyazic acid in the state of crystals. The process is as follows:

Dissolve 58 grs. of crystallized tartaric acid in spirit of wine, and pour the solution into a phial containing 50 grs. of ferruretted chyazate of potash dissolved in two or three drams of warm water; by this process the whole of the tartaric acid will combine with, and precipitate the potash in, the state of super-tartrate of potash, and the alcoholic fluid will contain nothing but ferruretted chyazic acid, which may be obtained from it in small crystals, generally resembling a cube, by spontaneous evaporation.

P. S. Since writing the above, I have made the experiment of decomposing ferruretted chyazate of potash by ignited peroxide of copper; I used one gr. of the salt with 35 grs. of the oxide; the products were, at mean temperature and pressure,

	Cubic Inches.
Carbonic acid	1·39
Azote	0·37
	1·76

The calculated products on the view which I took in my last letter are,

	Cubic Inches.
Carbonic acid	1·42
Azote	0·36
	1·78

The experiment, therefore, completely confirms the explanation which I then proposed.

Dr. Thomson employed too little peroxide of copper; and this, I believe, is the principal cause why his results differ from the above. I am, Gentlemen,

Your most obedient servant,

R. Porrett, Jun.

Article XII.

Some Account of Prof. Smith's Collection of Plants formed in the Neighbourhood of the River Zaire. Abridged from an Essay by Mr. Brown, published in Capt. Tuckey's Narrative.

Mr. Brown arranges his observations under three heads; in the first place he proposes to state what relates to the three primary divisions of plants; secondly, to notice whatever appears most remarkable in the several natural orders of which the collection consists; and thirdly, to compare the vegetation on the line of the river Zaire with that of other equinoctial countries.

The number of species in the herbarium somewhat exceeds 600; and although many of them are imperfect, yet they may all be referred to their primary division, and most of them to their natural families. With respect to the proportionate numbers of the three divisions, the dicotyledonous plants amount to 460, the monocotyledonous to 113, and the acotyledonous, including the ferns, to 33 species only. Mr. Brown observes, that it is important to ascertain whether a collection of plants that was made in two months, and not at a very favourable season of the year, can afford us sufficient data for forming any conclusion respecting the proportional numbers of the three primary divisions, or of the principal natural orders belonging to the country in which it was collected. In order to form a judgment in this respect, he compares the collection of Smith with those of other naturalists who have explored the neighbouring parts of the African coasts, or parts lying in similar latitudes, particularly that of Adanson, formed on the banks of the Senegal, those of Smeaton and Afzelius, procured from Sierra Leone, and that of Brass, collected near Cape Coast. The result of this comparison is very favourable to the value of the present herbarium; so that Mr. Brown concludes that it forms so considerable a part of the whole vegetation, as to enable us to determine with tolerable confidence the proportional numbers both of the primary divisions, and of the principal natural orders of the tract examined. Mr. Brown remarks that from the information which we at present possess, it would appear that the comparative number of species in equal areas within the tropics, and in the lower latitudes beyond them, has not been correctly estimated. Humboldt's observations on the American intertropical regions seem to prove that the western continent differs in this respect from the eastern; in Africa and New Holland, the richest districts would appear to be not those between the tropics, but about the latitude of the Cape of Good Hope.

In his essay on the botany of New Holland, Mr. Brown first pointed out the connexion between the climate of a country and the proportion of its primary divisions of plants; he particularly noticed the proportion between the dicotyledonous and monocotyledonous plants, which from the equator to about 30° N. is nearly as five to one; while beyond these limits there is a gradual diminution of the former, until at about 60° N. and 55° S. latitude, "they scarcely equal half their intertropical proportion." The observations of Humboldt lead to the same conclusion respecting the proportions of the primary divisions of the intertro-[illegible] although this may be established as the [illegible]ear that there are many deviations from this proportion; and these do not seem all of them to depend merely upon variations in temperature. We are informed that the proportion of the Congo collection, which is also that of the equinoctial part of New Holland, is found to exist both in North and South America, as well as in Van Diemen's island, and in the south of Europe.

In Prof. Smith's herbarium, the acotyledonous or cryptogamous plants are to the phænogamous as about 1 to 18; and there is reason, from different considerations, to suppose that this is not far from the actual proportion. In the parts of New Holland that are near the equator, the numbers are as about 1 to 13; but the proportion is very different in the different tropical regions; and this difference seems to depend, in a considerable degree, upon the elevation of the district; near the shores the proportion may be stated to be about 1 to 15; while in mountainous countries it is about as one to five.

The herbarium from Congo contains specimens from 87 of the natural orders, but more than half of them belong to nine orders only, being those which have their greatest number of species between the tropics, or at least in the lower latitudes; the orders are, the Filices, Gramineæ, Cyperaceæ, Convolvulaceæ, Rubiaceæ, Compositæ, Malvaceæ, Leguminosæ, and Euphorbiaceæ.

After describing in detail the plants in Prof. Smith's herbarium that belong to the different natural orders, Mr. Brown proceeds to compare the vegetation of the line of the river Zaire with that of other equinoctial countries, and with the various parts of the continent of Africa and its adjoining islands. With respect to the other parts of the west coast of Africa, it appears that from the river Senegal in 16° N. latitude to the Zaire in 6° S. latitude, there is a remarkable uniformity in the vegetation, not only with respect to the natural orders and genera, but even as far as respects the species. The same similarity seems also to exist in the cultivated as well as in the indigenous plants. On the banks of the river, as far as the expedition proceeded, the principal articles of vegetable food were found to be Indian corn, cassava, two kinds of pulse, and ground nuts. The most valuable fruits were plaintains, papaws, pumpkins, limes and oranges, pine apples, tamarinds, and a fruit called safa, like a small plum. A very valuable plant along the whole line of coast is the oil palm, elæis guineensis, from which the best kind of palm wine is produced. It appears also that the common yam, capsicum, two species of the sugar cane, and tobacco, were cultivated in particular spots. It is worthy of remark that the greatest part of these cultivated plants are not natives of the country, but have been introduced from other parts of the world, maize, cassava, pine apple, papaw, capsicum, and tobacco, were probably introduced from America, while the lanana, lime, *orange*, tamarind, and sugar cane, are probably *of Asiatic origin. In* determining to what country we are to refer the origin of plants that are now dispersed in various situations, Mr. Brown remarks that we may be assisted by a careful examination of the geographical distribution of genera. We may at least go so far as to conclude, that in doubtful cases it is more probable that the plant in question should belong to that country in which all the other species of the same genus are found decidedly indigenous, than to that where it is the only species of the genus known to exist. This mode of reasoning is applied to determine the native country of the banana, the papaw, the capsicum, and tobacco, about which there had been some difference of opinion among naturalists; the result is that we must refer the banana to Asia as its native climate, and the other three to America. Exceptions to this general rule will, however, probably be found; the cocoa-nut, for example, there is every reason to believe is indigenous in the coasts and islands of equinoctial Asia, yet it is the only species of its genus which does not exclusively belong to America.

There are some valuable plants that are cultivated in most of the western parts of Africa, yet were not observed in Congo; of these the most remarkable are the cocoa-nut, rice, and the sweet potatoe, convolvulus batatas.

The author observes that we have no means of determining the relation which the vegetation of the eastern shores of equinoctial Africa bear to the western. The flora of Abyssinia, as ascertained by Mr. Salt, has not much connexion with that of Congo, and the flora of Egypt has still less. The plants of Congo appear likewise to be very different from those of the south of Africa, containing none of the more remarkable genera and orders that are found in this district: there seems also to be very little affinity between the plants of Congo and those of the islands of St. Jago, or of St. Helena. There is rather more affinity between the vegetables of Congo and those of Madagascar, and the islands of France and Bourbon, and considerably more with those of India; while, on the contrary, they have less affinity with those of equinoctial America. It is observed, however, that there are several genera common to this part of Africa and America that have not yet been observed in India or New Holland; and there are more than 30 species in Prof. Smith's collection, which are also natives of the opposite coasts of Brazil and Guiana.

It has been questioned whether there be any species, especially of the dicotyledonous plants, which are found in the equatorial districts both of the old and the new continent. In order to elucidate this point, Mr. Brown has formed a list of the plants in Professor Smith's herbarium, which are common to Africa, America, and Asia; afterwards a list of those that are common to Africa and America, but are not found in India: and a third list of plants that are indigenous in
t not in America. The greater part of the
ese lists are strictly equinoctial plants,

although a few of them have been found in the southern parts of the temperate zone. Mr. Brown remarks, that some, or the whole of these plants, may be conceived to have been originally natives of only one of these countries, and may have been conveyed to the other either by accident or design; but he offers many considerations which render it probable that with respect to the greatest part of them this is not the case.

As to the proportion of new genera and species in Prof. Smith's collection, we have already stated the general facts in a note attached to the sketch which we gave of his life. The additions which he has made to our botanical knowledge are indeed very considerable; and when we reflect upon the short space of time which he spent in the country, and the unfavourable circumstances which attended the expedition, it cannot but impress our minds with a very high idea of his zeal and activity, and with the deepest regret for his premature death.

ARTICLE XIII.

ANALYSES OF BOOKS.

Transactions of the Geological Society, Vols. III. and IV.

(*Concluded from* p. 139.)

1. *Observations on the Geology of Northumberland and Durham.* By N. J. Winch, F.L.S.

This paper contains a very interesting account of the strata which occur in the counties of Northumberland and Durham; of which the following is a brief summary, beginning with the uppermost or newest of the series.

1. *Red Marl.*—This rock is seen on the north bank of the Tees, forming an irregular curve from near Darlington to the mouth of the river. It consists, as usual, of alternating beds of white, grey, and red calcareous sandstone, of red and blue slaty clay, and of gypsum. Borings to the depth of 120 fathoms have been made in this rock in an ineffectual search after coal. The springs arising from the blue marl of this deposit are not unfrequently impregnated with sulphuretted hydrogen.

2. *Magnesian Limestone.*—The country lying immediately to the north and west of the boundary of the red marl is of magnesian limestone. It forms the entire coast from Hartlepool to South Shields, and is seen coming up on the back of the coal strata along an irregular line from Shields to the Wear at Pallion, and thence running S.W. to Sellaby on the Tees.

The beds of this rock are thin, and are seen crossing slips and fractures in the subjacent coal strata without themselves undergoing any change; hence Mr. W. infers that the period of the deposition of this rock was subsequent to the disturbance, whatever it was, which has dislocated the beds of the coal formation. Although workings of coal have, in a few instances, been actually driven a little way under the cover of the magnesian limestone, yet all attempts to pierce through these beds in their dip, and so to reach the coal, have been fruitless. Large cavities in this limestone are filled by a breccia, the cement of which is a soft, marly, magnesian carbonate of lime; and where these occur in the cliffs on the coast, the action of the water upon them produces first large caverns, and then extensive slips and ruins, as may be observed at Hartlepool, Marsden, and Monk-Wearmouth.

The rock which appears the next in succession to the magnesian limestone is the coal formation. It occupies the face of the country west of the magnesian limestone, forms the coast from the mouth of the Tyne to that of the Coquet, proceeds up along the south bank of this river for five or six miles, whence it stretches to the Tyne about 10 miles above Newcastle, and terminates on the eastern extremity of Weardale and Teesdale forests. It rests, as usual, on a bed of very coarse sandstone, called the millstone-grit. The greatest depth to which any pit has been sunk in the coal measures is about 200 fathoms, and the entire thickness of the formation, as deduced from a succession of sections, appears not much to exceed 270 fathoms. Of the coal there are two varieties, namely, the common slate coal, and candle coal, called, in Northumberland, splint, or parrot coal. The other strata that compose the coal measures are shale (slaty clay) and micaceous sandstone of different degrees of fineness. The shales are either simply carbonaceous, or bituminous, and many of them when decomposed form a refractory clay proper for fire-bricks and potters' saggars. The grindstone sill is a fine grained sandstone, loosely aggregated, and forms the material of the celebrated Newcastle grindstones; the softer parts afford good filtering stones, and the yellow sand, which often constitutes the upper part of the bed, is sold to casters in iron, &c. as an ingredient in the composition of their moulds.

The organic remains, both vegetable and testaceous, are described by Mr. W.; and a particular account is given of the principal basaltic dykes by which the coal field is in various parts intersected.

The principal supply of the metropolis, of the eastern and part of the southern counties of England is derived from this coal field; hence the annual export from Newcastle, Sunderland, Hartley, and Blyth, amounts to about 2,000,000 London chaldrons.

The millstone grit, which has been already mentioned as supporting the coal formation, rests upon the *lead mine measures* which occupy nearly the whole of the counties of Durham and Northumberland to the north and west of the coal formation, with the exception of the Cheviot Hills. The strata rise about

W.N.W. at a low angle, and the entire thickness of the series has been estimated at 2700 feet and upwards. Some of the members of this formation agree with those of the coal-field, viz. coal, shale, and sandstone; but other beds also occur which sufficiently distinguish this formation from the preceding. These are sandstone with impressions of marine shells, shale, and limestone, containing fossil encrini, chert, and basalt, in apparent beds, or overlying masses.

The great mining fields of Aldstone, Dufton, and Arkendale, are situated in this formation, the lead ore being chiefly found in the thicker beds of limestone. The only abundant ore of lead is galena, which here yields about 60 per cent. of metal. The general average of silver which the lead contains is about 12 oz. per ton. About 9000 tons of lead, the produce of this district, are annually shipped from Newcastle and Stockton.

Calamine is worked in some places, and blende occurs in greater or smaller proportion in all the mines. Copper has been found in small quantities, but not in sufficient abundance to be worth working.

3. *Description of an insulated Group of Rocks of Slate and Greenstone in Cumberland and Westmoreland, on the east Side of Appleby, between Melmerby and Murton.* By the Rev. W. Buckland, Professor of Mineralogy in the University of Oxford, &c.

The district here described commences at the south-western extremity of the lead mine measures described in the preceding paper. These measures basset out, forming a series of lofty hills which extend N. and S. and form the great watershed of the country; the streams rising from their eastern slope running into the German Ocean, and those rising from their western slope running into the Irish Channel. The eastern side forms a series of precipitous faces, at the base of which the old red sandstone may be seen supporting the limestone, and resting upon the almost vertical edges of greywacke slate. On the western boundary of the slate is a line of greenstone, sometimes apparently vertical and adjacent to the slate, often covering it, and swelling into small hills; here and there the greenstone either is intersected by veins of a granite, chiefly composed of felspar, or, perhaps, itself passes into this rock. On the west of the greenstone the limestone formation appears to be resumed; but instead of being nearly horizontal and occupying a large tract, it is seen adjacent to the greenstone, in nearly vertical strata much broken and intermixed with each other, which soon disappear below the surface. Along the greatest part of the line the limestone is entirely wanting, and the red marl, exhibiting the usual characters of that rock, and forming nearly horizontal beds, abuts immediately against the greenstone. At the southern extremity of the tract here described, near Murton, the greenstone is wanting, and the red marl comes close up to the greywacke, and even in some cases covers the greywacke, and abuts against either the old sandstone, or even the nearly horizontal beds of the limestone series.

8. *On the Strata in the Neighbourhood of Bristol.* By Richard Bright, M.D. &c. *With Notes extracted from the Communications of George Cumberland, Esq.*

Note on Magnesian Breccia. By Henry Warburton, Vice-Pres. of the Geol. Soc.

9. *On the Magnesian Limestone and Red Marl, or Sandstone, of the Neighbourhood of Bristol.* By W. H. Gilby, M.D.

These papers contain further additions to the history of the rocks which form the subject of the two former communications. The district of which Bristol is the centre presents all the members of the series of British strata from the old sandstone upwards to the lias limestone; viz. the old sandstone, the encrinal limestone, the coal formation, the magnesian limestone, the red marl, and the lias limestone. The encrinal limestone of this district is sometimes, it seems, covered by conformable strata of magnesian limestone abounding in shells, entrochi, and madrepores.

The strata of the beds up to and including the coal formation are more or less elevated, and it is on the edges of these that the horizontal beds of the limestone conglomerate are deposited. This conglomerate in some places is of common limestone, and in others contains more or less of magnesian limestone. Of this conglomerate there appear to be two beds, incumbent on which are the marls and calcareous sandstones that form the red marl deposit. This latter, besides presenting the usual characters of the rock, includes veins and nodular masses of sulphate of strontian.

15. *Description of a Series of Specimens from the Plastic Clay, near Reading, Berks, with Observations on the Formation to which those Beds belong.* By the Rev. W. Buckland, Professor of Mineralogy in the University of Oxford, &c.

The plastic clay formation in its most extended sense includes the series of beds which exist between the chalk and the London clay in England, and the chalk and the calcaire grossier of the basin of Paris.

The immediate covering of the chalk is an alluvium of rolled and angular flint pebbles mixed more or less with sand and green earth; and at Reading, and in some other parts containing a peculiar species of oyster, together with small teeth of fish. Above this, lie various beds of sand and sandy loam, among which is a bed of fuller's earth; but the principal repository of this useful mineral is the sand below the chalk. The middle and upper part of the series is more clayey; and the uppermost bed is a loose sand supporting the London clay. This bed of sand in the London basin is filled with water, from which all the deep wells of the metropolis are supplied in inexhaustible abundance. Mr. Buckland's paper contains [illegible] interesting particulars respecting this deposit both in the basin and on the coast of Sussex.

Besides the papers already noticed (and which contribute in an eminent degree to elucidate the great geological features of the island) are many others very interesting, but for which we must refer our readers to the volume itself. Among these may be particularly distinguished, "Observations on the Mountain Cruachan," "Observations on the Hill of Kinnoul," "On the Parallel Roads of Glen Roy." All by Dr. M'Culloch. "Account of some remarkable Disturbances in the Veins of the Mine of Huel Pever, in Cornwall." By J. Williams. "Description of the Tunnel of the Tavistock Canal." By John Taylor. Two crystallographical papers. By W. Phillips. "Description of the Paramoudra." By the Rev. W. Buckland. "On the Gravel of Litchfield." By Arthur Aikin.

ARTICLE XIV.

Proceedings of Philosophical Societies.

ROYAL ACADEMY OF SCIENCES AT PARIS.

May 4.—M. le Marquis Dangeau sent the description of a new capstan.

M. Vauquelin, *élève ingenieur des ponts et chaussées,* communicated some observations on Sir W. Congreve's Canal Lock.

M. Biot read an extract of a letter from Mr. Pond, Astronomer Royal, relative to some recent experiments on the pendulum made at Greenwich. He also announces in the same letter his persuasion that the double annual parallax of Aquila, Arcturus, and Lyra, does not exceed a quarter of a second.

M. Berthollet made a report on the seventh memoir of M. Chevreul *sur les corps gras.*

M. Arago delivered in a report on the English Expedition to the Congo.

May 11.—M. Delambre gave an account of the new work of M. Bessel, on the Observations of Bradley.

M. de Manoury-d'Ectot gave in a description of his new Steam Engines, which was referred to a committee.

M. Thenard made a report on the memoir of MM. Pelletier and Caventou on Cochineal: the memoir was ordered to be published among the Sçavans étrangers.

M. Bosc made a report on the memoir of M. France on the Genus *Cabochon.*

In this memoir M. France proves that the Patella mitrata among recent and the Patella cornea among fossil shells, as well as several others, as yet undescribed, are in fact bivalves, and must, therefore, be referred to a new genus.

M. Girard read a memoir by M. le Gallois, on the Iron Railways of England.

The reading of a memoir, by M. Risso, entitled "A Geological Survey of the Environs of Nice," was begun.

May 18.—M. Laplace read a memoir on the Rotation of the Earth.

M. Arago made a report on a new work on Descriptive Geometry, by M. Vallée, Civil Engineer.

M. Girard made a report on the memoir of M. le Gallois on the Iron Railways of England.

In many parts of Germany it has been long the practice to fix wooden beams on the floor of galleries in mines, in order to ease the draft of the trucks and other carriages used in them. Of late years the English have extended this plan to carriage above ground, using iron bars instead of wood. The description of these iron railways forms the subject of M. le Gallois's memoir. According to him there are already in the vicinity of Newcastle 75 leagues of iron railway above ground, besides as much in the collieries below the surface. The subject is entered into in great detail by M. le Gallois, and the memoir is recommended for publication.

The reading of M. Risso's memoir on the Environs of Nice was concluded, and the memoir was referred to a committee.

M. Delambre made a report on the third volume of M. Peyrard's translation of Euclid.

The committee find in the present volume the same fidelity of translation as in the two former ones. The various readings fill 84 pages. The editor has asserted that the splendid Oxford edition contains all the errors, even the most palpable ones, of the Basle edition, besides many others which are peculiar to it; and this assertion is substantiated by a comparative view of the two editions occupying eight pages.

Article XV.

SCIENTIFIC INTELLIGENCE, AND NOTICES OF SUBJECTS CONNECTED WITH SCIENCE

I. *Lectures.*

Mr. Clarke's and Mr. Blagden's lectures on midwifery and the diseases of women and children will commence on Monday, Oct. 5. The lectures are read every morning from a quarter past ten to a quarter past eleven, for the convenience of students attending the hospitals.

Mr. Guthrie, Deputy Inspector of Military Hospitals, will commence his winter course of lectures on surgery, on Monday, Oct. 5, at 5 minutes past 8 in the evening, in the waiting room he *Royal* Westminster Infirmary for Diseases of the Eye, hone-street, Piccadilly. To be continued on Mondays, Wednesdays, and Fridays.—The diseases of the eye, although forming an integral part of the lectures on surgery, will, for the convenience of illustration, be delivered every Thursday evening until completed.

II. *Remarks on the Tails of Comets.* By H. Flaugergues.*

A series of papers by M. Flaugergues, has been lately published in the Journal de Physique, on the tails of comets, in which he examines in detail the various hypotheses that have been proposed to account for them, but conceives them all to be inadequate. After taking a short review of the opinions entertained on this subject by the ancients, and the earlier of the moderns, he examines more particularly those of Kepler and Descartes, and finally comes to that of Newton. This great philosopher conjectured that the tails of comets were composed of an extremely rare vapour, which proceeded from their nucleus, generated by the great heat which these bodies acquire when they approach the sun. He formed a calculation of the degree of heat which the comet of 1680 would experience in its perihelion; and he estimated it at a temperature 2000 times greater than the heat of red-hot iron.

To this hypothesis M. Flaugergues objects, that on account of the rapidity of the motion of comets, it is very doubtful whether they can acquire a degree of heat nearly equal to that assigned to them by Newton. Besides, it is remarked that the tails of comets are by no means in proportion to their proximity to the sun; some comets which have approached very near the sun having had very little of this appearance, while others have had large tails, although they never came very near the sun in any part of their course. Another objection against the hypothesis is, that the centrifugal force which is produced by the motion of the comet in a curve round the sun, being common to the comet and to the vapour which is supposed to form the tail, cannot tend in any degree to detach the comet and the vapour from each other. It is further urged that the greatest part of the matter which composes the tail of a comet ought, after it has passed its perihelion, to follow after the comet in the direction of its motion, and not precede it, as is always the case. Again, the matter which forms the tail of a comet, being surrounded with matter which is more dense, and which, consequently, ought to reflect light more strongly, the tail ought not to be distinguished by its brilliancy from the other parts of space. As, according to the hypothesis of Newton, the vapour which forms the tail of a comet is elevated from the nucleus because it has less specific gravity than the medium with which it is surrounded, the lateral motion of the tail should be entirely destroyed by the resistance of this medium; the matter of the tail, not being able to follow the comet, would be always left behind, and we should not see the tail after the perihelion precede the comet, as is always the case.

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* Abridged from Journ. Phys. for Feb. 1818.

III. *Biographical Notice of Dr. Wistar, of Philadelphia.*[*]

Dr. Caspar Wistar was born at Philadelphia in the year 1760; his parents were of German extraction, and belonged to the society of friends. He received the first part of his education at the grammar school of his native city; he commenced his medical studies under the superintendance of Dr. Redman, and he likewise attended the lectures of Drs. Morgan, Shippen, Rush, and Kuhn. In the year 1783 he came over to this country, in order to pursue his studies in the University of Edinburgh; in 1786 he graduated there, and in the following year returned to his native city, where he settled for the remainder of his life.

There appears, at this period, to have been two rival medical schools in Philadelphia, one attached to the University, and the other denominated the College; he was invited to the Professorship of Chemistry and Physiology in the latter of these institutions, which he accepted. After some time, however, these two rival establishments were united in the University of Pennsylvania, of which Dr. Wistar was made joint professor of Anatomy and Surgery with Dr. Shippen. In this situation he continued until his death, and appears to have been completely occupied with the duties of this office, in conjunction with those of medical practice. All his publications seem to have been of a professional nature, and to have been chiefly confined to papers in the American periodical works. His principal literary distinction he obtained only a short time before his death. His biographer informs us, "that when the presidency of the American Philosophical Society for promoting useful Knowledge was vacated in 1816, Dr. Wistar, by an unanimous suffrage, was elected to fill that honourable station: honourable, as having been previously occupied only by his illustrious predecessors, a Franklin, a Rittenhouse, and a Jefferson."

IV. *Experiments on Metallic Alloys obtained by Means of Galvanism.* By Prof. Brugnatelli.[†]

If we plunge a plate of zinc into a dilute solution of the nitrate of silver, the silver attaches itself to the zinc; two electric poles are then established, by which the water is decomposed. The oxygen which is attracted to the positive zinc pole oxidates it, and the hydrogen which is attracted to the negative silver pole serves to oxidate the metal which has been dissolved. But the zinc which is oxidated is also dissolved by the acid which is liberated, and there is formed a mixed solution of nitrate of zinc and of silver.

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[*] Abstracted from a tribute to the memory of the late C. Wistar, M.D. &c. by his friend Dr. Hosack.

Journ. iii. 425. (Sept. 1817.)

The nascent hydrogen from the negative pole reduces the silver and the zinc at the same time. The zinc plate is covered with a flocculent mass, of a blackish colour, which is in the state of an hydrate; the flocculent surface gradually becomes grey and brilliant: this appears to be an alloy of silver and zinc in the form of an hydrate.

In the same manner when a plate of zinc is suspended in a solution of the acetate of lead, the arborization with brilliant facets which is produced is an alloy of lead and zinc, not, as was formerly supposed, pure lead. An alloy of zinc and copper is formed, when we place a plate of zinc in a solution of the acetate of copper. In this case a blackish matter is produced, consisting of zinc and copper, which, by means of the burnisher, may be made to assume a very beautiful polish of the colour of gold.

What is called the arbor Dianæ is a solid amalgam of mercury and silver; if we add to the solution of silver and mercury generally employed in the above experiment some nitrate of copper, we obtain large, brilliant crystals of silver, mercury, and copper.

V. *Chemical Researches on the Pellitory of Spain.* By M. Gautier, Apothecary in Paris.*

The most remarkable quality of the pellitory of Spain, the Anthemis Pyrethrum, is the acrid, burning sensation which it produces upon the mouth when it is chewed, and the profuse salivation which it excites. A quantity of the pulverized root was successively acted upon by sulphuric ether, boiling alcohol, cold water, and afterwards by boiling water, the products of each step of the process being accurately examined. The general results are, that the acrid property of the pyrethrum depends upon an oil, which exists only in the bark, and which, by a close inspection of the part, may be seen lodged in minute vesicles. The author calls this a fixed oil, and says that it possesses the following properties; it has a reddish colour, a powerful odour, is insoluble in water, lighter than this fluid, becoming concrete by cooling, and melting again by heat; it forms a saponaceous compound with the alkalies, the soaps being soluble in water and in alcohol. Besides this fat or fixed oil, M. Gautier mentions a volatile oil as one of the constituents of the pyrethrum; we are rather disposed to think that this is the immediate cause of the acrid properties, and that the effects of the fixed oil depend upon its being combined with a portion of the volatile oil. It also contains a yellow colouring matter, which appears to be of the nature of a gum-resin, and a substance resembling a gum, which, however, is principally characterized by its negative properties.

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* *Abridged from* Journ. Pharm. iv. 49. (Feb. 1818.)

After the root had gone through the successive action of the ether, the alcohol, and the cold water, boiling water extracted from it $\frac{1}{3}$ of its whole weight of what M. Gautier supposes to be inulin, the vegetable principle which was discovered by Rose in the root of elicampane, the inula helenium. The substance is described as being white, pulverulent, insipid, inodorous, soluble in boiling water, which it renders viscid, insoluble in cold water, alcohol, and ether. Iodine poured into a boiling solution of this substance produces a yellow precipitate, which is gradually deposited. When it is heated in a capsule, it is decomposed, and an odour is produced exactly similar to that of caromel. Alcohol poured into an aqueous solution of this substance instantly produces a precipitate which is at first flaky, but afterwards, when it is collected at the bottom of the vessel, is pulverulent. Traces of muriate of lime were also found in the pyrethrum. The following are the proportions in which M. Gautier supposes its constituents to exist.

Volatile oil (traces)	
Fixed oil	5
Yellow colouring principle	14
Gum	11
Inulin	33
Muriate of lime (traces)	
Woody matter	35
	98
Loss	2
	100

With respect to inulin, we may remark that its characters, as laid down by Rose, are somewhat indefinite, or indicative rather of a variety of starch than of a specifically different principle. The effect of iodine upon it, as stated by the author, deserves to be attended to, and would appear to give it a more decided character; but until we are better acquainted with the action of iodine upon other vegetable substances, it may be doubted whether it is to be considered as denoting a variety or a species.

VI. *On the Linear Flow of different Liquids through Capillary Tubes of Glass.* By M. Girard.*

Fluids are divided by M. Girard into two classes, according as they adhere or do not adhere to glass. The experiments were all made with the same vessel, and they are all reduced by calculation to the same pressure of the fluid upon the orifice of the tube, while different fluids were employed, and the same fluid at different temperatures. The results of the experiments are given in a tabular form; we have arranged in separate columns, first,

* Abstracted from a memoir read to the Royal Academy of Sciences, Jan. 1817.

the date of the experiment; secondly, the temperature of the fluid employed; thirdly, its density; and fourthly, the time in which a given quantity of it flowed through the tube. Some of the principal facts which M. Girard ascertained were as follows: the rate of the flow of pure water is four times as great at the temperature of 194° (Fahr.) as at 32°; the rate of the flow of alcohol is not so rapid, although it is considered to be more perfectly fluid than water: this depends upon a greater attraction which glass possesses for alcohol than for water, from which circumstance it follows that there is a stratum of the alcohol in the interior part of the tube, which is thicker than that formed by water, and proportionally obstructs the passage. A solution of sugar in water, although much more viscid than alcohol, flows out more rapidly; but, in general, all these differences are less as the temperatures become more elevated. M. Girard performed a series of experiments upon an aqueous solution of nitrate of potash; he found that the rate of its flow was less rapid than that of water, except at high temperatures, when they became more nearly the same.

Some other circumstance, besides viscidity and temperature, appears to affect the results; if we introduce a thread into the mouth of a capillary tube, through which the fluid escapes only in drops, the flow becomes a continued stream, although, in the two cases, the quantity of fluid discharged in the same time is equal. It was found that the effect of temperature upon the rate of the flow diminishes as we increase the diameter of the bore of the tube.

By comparing together the results of all the experiments, we arrive at the general principle; that when we employ the same fluid, the time in which the same quantity flows out is in the direct ratio of the temperatures and the inverse ratio of the cube of the diameter of the tube. We may represent it by a geometric curve, of which the abcisses will indicate the degrees of the thermometer, and the ordinates the times necessary for the flow of the same bulk of fluid. With respect to the comparative rate of the flow of different fluids, it depends upon the affinity between the tube and the different fluids, with which we are yet only imperfectly acquainted.

VII. *Analysis of the Chenopodium Olidum.* By MM. Chevalier and Lasseigne.*

We are informed by these chemists that the analysis of this plant offers some very remarkable results, of which the most singular is that it contains a quantity of uncombined ammonia. This is supposed to be the vehicle of the remarkably nauseous odour which it exhales, strongly resembling that of putrid fish.

When the plant is bruised with water, the liquor expressed, and afterwards distilled, we procure a fluid which contains the subcarbonate of ammonia and an oily matter, which gives the fluid a milky appearance. If the expressed juice of the chenopodium be evaporated to the consistence of an extract, it is found to be alkaline, there seems to be acetic acid in it, while its basis is said to be of an albuminous nature. It is stated also to contain a small quantity of the substance which the French call osmazome, a small quantity of an aromatic resin, and a bitter matter soluble both in alcohol and in water, as well as several saline bodies. The following is stated as the result of the analysis, which, however, we may remark is so complicated and so peculiar, that we should be glad to see it confirmed by further experiments.

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* *Abridged from Journ. Pharm.* iii. 412. (Sept. 1817.)

The various constituents of the chenopodium olidum are as follows;

1. Subcarbonate of ammonia.
2. Albumen.
3. Osmazome.
4. An aromatic resin.
5. A bitter matter.
6. Nitrate of potash in large quantity.
7. Acetate and phosphate of potash.
8. Tartrate of potash.

It is said that 100 pounds of the dried plant produce 18 pounds of ashes, of which 5½ are potash.

VIII. *Experiments on the Bilberry, and on the Method of detecting extraneous Colours in Red Wine.* By M. Vogel.*

The berries of the vaccinium myrtillus contain a colouring matter, the citric and the malic acids, and a considerable quantity of uncrystallizable sugar. The colouring matter may be removed by boiling the juice of the bilberry with powdered charcoal, or with an argillaceous earth; by this process it is rendered as colourless as water. When the berries are bruised, the pulp seems to be scarcely susceptible of undergoing the process of fermentation, on account of the great proportion of sugar which it contains; by diluting it with about an equal bulk of water, and still more by adding yeast to it, it readily ferments, and forms alcohol in considerable quantity.

With respect to the colouring matter of wine, M. Vogel remarks, that of all the substances which he has employed to give them a red colour, none of them form with the acetate of lead a greenish grey precipitate, which is the colour that is procured from the genuine red wines. Wines coloured by the juice of the bilberry, by elder, or by Campeachy wood, form with acetate of lead a precipitate of a deep blue colour; Fernanbouc, red saunders, and the red beet, produce a colour which is precipitated red by the acetate of lead. When wine is coloured merely by beet, it may be rendered entirely colourless by lime water, but the weakest acid will bring back the colour; it may be reproduced even by blowing into the fluid through a tube. As the colouring matter of red wines is supposed to reside principally in the skin of the grape, the author prepared a quantity of the skins, and reduced them to powder. In this state he found that they were not soluble in ether, but that they communicated to alcohol a deep red colour; a paper stained with this colour was rendered red by acids and green by alkalies.

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* Abridged from Journ. Pharm. iv. 56. (Feb. 1818.)

M. Vogel informs us that he made a quantity of red wine from black grapes for the purpose of his experiments, and that this produced the greyish green precipitate with the acetate of lead; he also found the same coloured precipitate in two specimens of red wine, the genuineness of which could not be suspected, the one from Château-Marguaux, and the other from the neighbourhood of Coblentz.

IX. *On the Combinations of the Phosphuretted Hydrogenous Compounds with the Hydriodic Acid.* By M. Houton Labillardiere.*

The author proposes to give an account of the combinations of both the protophosphuretted hydrogen and the perphosphuretted hydrogen with hydriodic acid gas. By protophosphuretted hydrogen, he informs us that he means the phosphuretted hydrogen which is disengaged by heat from phosphorous acid formed by the action of the air; and by perphosphuretted hydrogen, that which is obtained from a mixture of phosphorus in excess, lime, and water, the first portions only being collected of what is disengaged by means of heat.† Protophosphuretted hydrogen gas is distinguished from the perphosphuretted in its not having the property of inflaming merely by the contact of the air, and of not depositing phosphorus, both which circumstances occur in the perphosphuretted hydrogen. He observes, however, that the protophosphuretted hydrogen will inflame in atmospherical air, provided it be rarefied at ordinary temperatures, but at low temperatures a greater degree of rarefaction is necessary.

When protophosphuretted hydrogen and hydriodic acid are mixed together over mercury with the proper precautions, we obtain on the sides of the jar a layer of white cubical crystals, which are decomposed by the contact of water, the protophosphuretted hydrogen being disengaged, and the hydriodic acid being dissolved in the water. It is said that alcohol when freed from water decomposes this compound, and it is also decomposed by ammoniacal gas; but most other re-ageuts, provided they be perfectly dry, do not act upon it. The combination of perphosphuretted hydrogen is formed in the same manner with the protophosphuretted; it possesses nearly the same properties, except that when it is decomposed by water, it is converted into protophosphuretted hydrogen, with the deposition of phosphorus and hydriodic acid, and that when it is acted upon by ammoniacal gas, it disengages half the volume of the ammoniacal gas, with a deposition of phosphorus.

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* Abstracted from Journ. Pharm. iii. 454. (Oct. 1817.)

† The first of these substances has been also named hydrophosphoric gas, or bihydroguret of phosphorus, and appears to consist of one atom of phosphorus to two atoms of hydrogen; the second, which has been called simply phosphuretted hydrogen, or hydroguret of phosphorus, appears to consist of one atom of each of its ingredients.

M. Houton Labillardiere draws the following conclusions from his experiments. 1. That protophosphuretted hydrogen is inflammable at ordinary temperatures in atmospheric air, or in oxygen sufficiently rarefied; 2. That each of the phosphuretted hydrogens combine with the hydriodic acid; 3. That these compounds possess different properties; 4. That the compound formed with protophosphuretted hydrogen gas consists of equal volumes of the two ingredients; but that the compound formed with perphosphuretted hydrogen gas consists of one volume of this gas to two of the hydriodic acid gas; 5. That the phosphuretted hydrogens contain the same volume of hydrogen, and that perphosphuretted hydrogen does not change in bulk when it is converted into protophosphuretted hydrogen; 6. That from the analogy which exists between azote and phosphorus, we may compare their compounds to ammoniacal salts, and may designate these combinations, the hydriodates of the phosphuretted hydrogens.

X. *On Mr. Tritton's Distilling Apparatus.*

(To the Editors of the *Annals of Philosophy.*)

GENTLEMEN, 63, *Whitechapel*, *Aug.* 14, 1818.

I beg to acquaint you that since writing the account of my improved apparatus for distilling, inserted in your number for June last, I have erected one of 400 gallons for trial at this place. It has been worked both with water and spirits, and the result has been most satisfactory, from the regularity and expedition with which the still works, the small consumption of fuel, and the improved quality of spirit. A correspondent in the number of the *Annals* for July, quoting an opinion entertained by Dr. Black and Mr. Watt, that there would be no saving of fuel by distilling in vacuo, I trouble you with this letter to state that the experiments made both on the small scale and with the apparatus just referred to are entirely opposed to such an opinion; and that Mr. Benwell, who has been for 30 years engaged in the malt distillery, and Mr. John Bockett, Jun. an eminent rectifier, permit me to express their entire confidence, from observation on the working of the still, that a material saving of fuel is effected by the use of my improved apparatus. I take this opportunity of stating that I have many times distilled malt wash by surrounding my still with water of the temperature of 160°. Now this operation could not be effected in a common still by surrounding it with water of the temperature of 212°; nor could the ebullition in the common still, if produced by other means, be maintained by the heat of 212° in the surrounding water. It appears then that a lower heat suffices to commence distillation in vacuo, and that a less heat suffices to maintain the operation when begun; of course there is a less expenditure of fuel. I shall be obliged by the insertion of this letter in your next number; and I am, Gentlemen,

Your obedient servant,
HENRY TRITTON.

XI. *Parhelion and Parhelia, seen at Gosport, Aug.* 26, 1818. By William Burney, Esq. LL.D

At half-past six, a. m. a fine parhelion appeared on a thin vapour passing to a *Cirrostratus* cloud; it was situated E. by N., and its altitude from the horizon, allowing for the necessary corrections, was 15°; its distance from the true sun, which bore E. by S. by the compass, was 22° 30′; and its continuance upwards of half an hour. No halo round the sun was perceptible at the time.

At half-past seven, a beautifully coloured *parhelia* appeared on an attenuated *Cirrostratus;* namely, one on each side of, and both horizontal with, and equidistant from, the real sun, which was then 22° in altitude. These two mock-suns sometimes appeared at the same time for two or three minutes, and at other times alternately, when their colours were brightest: they disappeared twice from the intervention of clouds; and, at the place of their re-appearance, a bright light was first perceived in the cloud, gradually forming into the shape of a cone lying horizontally with its apex turned from the sun; and at the base of this cone, nearest the sun, there was a light red, a delicate yellow, and lastly a pale blue, which altogether formed the mock-sun: when the *parhelia* appeared most perfect, they were circular, of an orange colour, and nearly as large again as the apparent size of the sun's disc: only two parts of the solar halo in which they were situated could be traced; and these were perpendicular through the *phenomena,* which did not disappear till after eight o'clock.

The State of the Clouds and Instruments.—During this rare and pleasing sight, there were, in the vicinity of the sun, *Cirrocumuli* and plumose *Cirri* descending to *Cirrostrati,* and *Cumulus* clouds rising in the W. from whence a fresh breeze and vapour sprang up. The barometer at 30 inches, but sinking slowly; the thermometer rose from 56° to 62°; and De Luc's whalebone hygrometer receded from 65° to 60°. Before 10 o'clock, the azure sky was completely veiled with compound modifications of clouds, followed by large passing *Nimbi* and a few drops of rain.

Article XVI.

Astronomical, Magnetical, and Meteorological Observations. By Col. Beaufoy, F.R.S.

Bushey Heath, near Stanmore.

Latitude 51° 37′ 42″ North. Longitude west in time 1′ 20·7″.

Astronomical Observations.

July 15.	Immersion of Jupiter's third satellite	9h	32′	30″	Mean Time at Bushey.
		9	33	51	Mean Time at Greenwich.
15.	Immersion of Jupiter's second satellite	12	27	21	Mean Time at Bushey.
		12	28	42	Mean Time at Greenwich.
15.	Emersion of Jupiter's third satellite	12	52	13	Mean Time at Bushey.
		12	53	34	Mean Time at Greenwich.
23.	Emersion of Jupiter's first satellite	11	15	54	Mean Time at Bushey.
		11	17	17	Mean Time at Greenwich.

Magnetical Observations, 1818. — *Variation West.*

Month.	Morning Observ.					Noon Observ.					Evening Observ.				
	Hour.		Variation.			Hour.		Variation.			Hour.		Variation.		
July 1	8h	25′	24°	32′	21″	1	30′	24°	45′	29″	7h	25′	24°	36′	56″
2	8	25	24	33	52	1	25	24	42	34	7	35	24	37	58
3	8	30	24	35	49	1	25	24	44	18	7	35	24	38	30
4	8	25	24	31	24	1	30	24	45	80	7	30	24	39	35
5	8	30	24	32	58	1	40	24	44	55	7	40	24	37	48
6	8	25	24	35	17	1	30	24	46	39	7	35	24	38	14
7	8	35	24	33	23	1	25	24	44	49	7	35	24	38	08
8	8	25	24	32	34	1	30	24	43	48	7	30	24	38	29
9	8	30	24	34	09	1	35	24	47	16	7	30	24	39	02
10	8	30	24	34	45	1	30	24	47	40	7	35	24	88	57
11	8	25	24	32	16	1	35	24	43	51	7	35	24	38	39
12	—	—	—	—	—	1	25	24	43	44	—	—	—	—	—
13	8	30	24	35	05	—	—	—	—	—	7	30	24	39	09
14	8	35	24	35	37	1	30	24	42	58	7	35	24	39	30
15	8	30	24	37	02	1	25	24	46	43	7	30	24	37	52
16	8	30	24	33	15	1	15	24	44	19	—	—	—	—	—
17	8	25	24	35	03	1	20	24	46	26	7	35	24	37	57
18	8	30	24	35	47	1	30	24	43	19	7	30	24	38	07
19	8	35	24	33	45	1	10	24	45	36	7	20	24	37	31
20	8	30	24	37	40	1	20	24	45	03	7	30	24	38	46
21	8	30	24	35	14	1	20	24	45	11	—	—	—	—	—
22	8	30	24	33	44	1	25	24	46	13	7	30	24	37	16
23	8	30	24	34	57	1	25	24	47	01	7	30	24	41	01
24	8	30	24	34	24	1	25	24	42	58	7	10	24	38	36
25	8	25	24	35	13	1	35	24	44	51	7	35	24	37	02
26	8	30	24	33	40	1	30	24	44	01	7	30	24	38	38
27	8	35	24	34	38	1	55	24	42	43	—	—	—	—	—
28	8	25	24	35	00	1	25	24	45	58	7	25	24	35	54
29	8	30	24	34	56	1	25	24	45	12	7	25	24	38	15
30	8	30	24	35	30	1	25	24	44	26	7	25	24	36	27
31	8	25	24	32	29	1	15	24	45	50	—	—	—	—	—
Mean for Month.	8	29	24	34	24	1	27	24	44	59	7	30	24	38	14

Meteorological Observations.

Month.	Time.	Barom.	Ther.	Hyg.	Wind.	Velocity.	Weather.	Six's.
July		Inches.				Feet.		
1	Morn....	29·730	66°	42°	WNW		Fine	57°
	Noon....	29·683	73	32	W	—	Cloudy	75
	Even	29·630	68	37	N		Cloudy	
2	Morn....	29·640	62	40	E		Fine	58½
	Noon....	29·667	69	33	ESE	—	Cloudy	71
	Even	29·700	61	38	SE		Cloud y	
3	Morn....	29·768	60	43	SW		Very fine	52½
	Noon....	29·755	71	25	W	—	Fine	73
	Even	29·720	60	28	N by W		Cloudy	
4	Morn....	29·652	60	43	NW		Cloudy	59
	Noon....	29·663	68	36	NW	—	Cloudy	71
	Even	29·645	66	35	NW		Fine	
5	Morn....	29·648	65	44	NNW		Cloudy	55
	Noon....	29·638	71	34	N	—	Fine	72½
	Even	29·640	67	37	NW		Fine	
6	Morn....	29·668	66	43	NE		Very fine	56
	Noon....	29·675	74	31	Var.	—	Misty	79
	Even	29·660	69	38	SSE		Fine	
7	Morn....	29·585	66	41	SE by S		Fine	57
	Noon....	29·530	76	31	Var.	—	Fine	77
	Even	29·460	66	38	Var.		Cloudy	
8	Morn....	29·432	62	44	W by N		Cloudy	56
	Noon....	29·463	67	32	NW by N	—	Fine	71
	Even	29·547	64	31	NNW		Fine	
9	Morn....	29·676	60	40	NNW		Very fine	51
	Noon....	29·700	71	27	NNW	—	Fine	72
	Even	29·700	66	36	Calm		Cloudy	
10	Morn....	29·670	64	36	SW		Fine	64
	Noon....	29·635	70	34	W by S	—	Fine	72
	Even	29·600	65	47	S		Cloudy	
11	Morn....	29·548	64	32	NW		Cloudy	55
	Noon....	29·515	72	29	Var.	—	Cloudy	73
	Even	29·470	66	37	WNW		Cloudy	
12	Morn...	29·373	—	75	N		Rain	61
	Noon....	29·367	71	44	NW by N	—	Cloudy	71½
	Even	—	—	—	—		—	
13	Morn....	29·468	64	58	W		Sm. rain	58
	Noon....	—	—	—	—	—	—	73½
	Even	29·643	67	42	NNW		Very fine	
14	Morn....	29·790	64	49	NW by N		Very fine	55
	Noon....	29·818	75	34	Var.	—	Very fine	79
	Even	29·820	73	39	Calm		Lightshowers	
15	Morn....	29·900	68	45	NE by E		Very fine	60
	Noon....	29·877	78	32	NNE	—	Very fine	79¾
	Even	29·875	72	45	E		Very fine	
16	Morn....	29·844	70	44	W		Fine	61
	Noon....	29·723	82	31	Var.	—	Fine	84
	Even ...	—	—	—	—		—	
17	Morn....	29·763	69	44	E by N		Cloudy	65½
	Noon....	29·753	71	44	Calm	—	Showery	76
	Even	29·710	67	35	E	3·725	Cloudy	
18	Morn....	29·655	68	45	ENE		Fine	58
	Noon....	29·605	72	35	ENE	8·141	Cloudy	75
	Even	29·565	69	38	ENE		Cloudy	

Meteorological Observations continued.

Month.	Time.	Barom.	Ther.	Hyg.	Wind.	Velocity.	Weather.	Six's.
July		Inches.				Feet.		
19	Morn....	29·505	69°	43°	NE		Fine	59°
	Noon....	29·510	73	35	Calm	—	Much thund.	77
	Even	29·513	66	45	NW		Showery	60
20	Morn....	29·523	64	52	N		Cloudy	
	Noon....	29·556	72	38	NNW	3·787	Fine	74½
	Even....	29·546	68	40	NNW		Very fine	57
21	Morn....	29·532	62	43	WSW		Fine	
	Noon....	29·530	71	36	W by S	5·856	Cloudy	73
	Even	—	—	—	—		—	59
22	Morn....	29·620	66	46	W by S		Cloudy	
	Noon....	29·673	75	31	W	7·826	Fine	78
	Even	29·670	74	35	SW by W		Fine	60
23	Morn....	29·685	71	44	SE		Very fine	
	Noon....	29·673	82	25	SE	4·231	Very fine	83½
	Even ...	29·600	73	33	E		Very fine	66
24	Morn....	29·443	77	42	ESE		Fine	
	Noon....	29·438	88	21	SSW	7·495	Fine	89½
	Even	29·437	83	23	SSW		Thunder	65½
25	Morn....	29·400	71	40	WSW		Fine	
	Noon....	29·410	79	29	SSW	11·807	Fine	79½
	Even	29·420	70	36	SW		Fine	61
26	Morn....	29·435	71	42	SSE		Fine	
	Noon....	29·407	80	27	SSW	9·356	Fine	81
	Even....	29·405	69	51	S		Showery	64
27	Morn....	29·400	70	50	SSW		Cloudy	
	Noon....	29·420	62	55	WNW	5·313	Thund., rain	76
	Even....	29·533	—	56	NNW		Rain	51
28	Morn....	29·747	59	42	NW		Very fine	
	Noon....	29·786	68	30	NNW	5·079	Very fine	70
	Even	29·793	64	34	NW		Very fine	57
29	Morn....	29·800	64	40	SW		Cloudy	
	Noon....	29.800	71	39	SW	5·363	Cloudy	71½
	Even	29·780	68	47	W		Fine	60
30	Morn....	29·715	66	48	W		Cloudy	
	Noon....	29·715	76	37	W by S	5·635	Fine	77
	Even	29·710	70	42	W by S		Cloudy	60½
31	Morn....	29·687	67	50	W by N		Cloudy	
	Noon....	29·636	71	48	SW	—	Showery	74
	Even	—	—	—	—		—	

Rain, by the pluviameter, between noon on the 1st of July and noon on the 1st of August, 0·67 inches. The quantity that fell on the roof of my observatory, during the same period, 0·633 inches. Evaporation, between noon the 1st of July and noon the 1st of August, 7·015 inches.

ARTICLE XVII.

METEOROLOGICAL TABLE.

1818.	Wind.	Barometer. Max.	Barometer. Min.	Barometer. Med.	Thermometer. Max.	Thermometer. Min.	Thermometer. Med.	Hygr. at 9 a. m.	Rain.	
7th Mon.										
July 25	S W	29·85	29·80	29·825	77	54	65·5			●
26	S	29·85	29·80	29·825	84	62	73·0	45	2	
27	N	30·22	29·80	30·010	79	51	65·0	52		
28	S W	30·27	30·22	30·245	72	47	59·5	37		
29	S W	30·27	30·16	30·215	81	56	68·5	40		
30	S W	30·16	30·10	30·130	82	59	70·5	40		
31	W	30·10	29·97	30·035	80	58	69·0	46	12	
8th Mon.										
Aug. 1		30·18	30·03	30·105	70	50	60·0	52		
2	S	30·18	30·10	30·140	70	43	56·5	50		☽
3	S	30·10	30·07	30·085	79	47	63·0	48		
4	S E	30·10	30·05	30·075	87	50	68·5			
5	E	30·03	30·00	30·015	93	57	75·0			
6	N	30·09	30·03	30·060	88	59	73·5	40	—	
7	N W	30·10	30·07	30·085	76	52	64·0			
8	N W	30·10	29·95	30·025	78	53	65·5			
9		29·95	29·87	29·910	82	56	69·0	52		○
10	N E	30·20	29·95	30·075	72	43	57·5			
11	N E	30·20	30·10	30·150	70	50	60·0	47		
12	N E	30·13	30·07	30·100	72	46	59·0	50		
13	N E	30·13	30·10	30·115	76	45	60·5	47		
14	N E	30·10	30·08	30·090	71	53	62·0			
15	N E	30·11	30·08	30·095	68	53	60·5			
16	N	30·08	30·00	30·040	76	46	61·0			☾
17	N	30·00	29·90	29·950	76	45	60·5		—	
18	N W	29·94	29·88	29·910	77	50	63·5			
19	N	30·04	29·94	29·990	66	46	56·0		—	
20	N	30·04	30·03	30·035	66	50	58·0			
21	N W	30·06	30·00	30·030	71	44	57·5			
22	N W	30·20	30·06	30·130	66	43	54·5	39		
		30·27	29·80	30·051	93	43	63·32	45	0·14	

The observations in each line of the table apply to a period of twenty-four hours, beginning at 9 A. M. on the day indicated in the first column. A dash denotes, that the result is included in the next following observation.

REMARKS.

Eighth Month.—4. With the exception of a gentle rain in the evening of seventh month, 31, the steady, fine weather has continued. Much *Cirrocumulus* of late. This day, in travelling, I observed the clouds, both at sun-rise and sun-set, beautifully coloured with a double gradation of tints, in which the respective effects of the direct and refracted rays were very distinctly marked. 6. Wind in the morning, SE, brisk, with *Cirrostratus* and *Cirrocumulus;* the latter formed in one instance out of *Cirrus* with unusual rapidity: the wind veered gradually from SE by SW to NE: at nine, p. m. a strong breeze blowing, with an appearance of rain to NW, it began to lighten: at first, a very faint blue flash; then others, gradually increasing in intensity at intervals of about a minute, filling the air, without being referrible to any point of the compass, followed generally by a sudden puff of wind, and without thunder. In 20 minutes, however, thunder began to be heard in the W and NW, and a storm passed in view to the NE, the flashes broad and vivid on the whole North horizon, and crossed by delicate striæ of a different colour. We had only a few drops, and it was over in two hours. 7. The sun-set was more richly coloured with yellow (passing at length through orange to lake and purple) than I remember ever to have seen it in this tint before. It literally glowed like a bright flame on the lower surface of some dense *Cirri*, passing to *Cirrocumulus;* which modification was well marked afterwards. 9. A fine coloured sun-set again, but in deep orange passing to red, and succeeded by *Cirrostratus.* 10. Cloudy, with a brisk wind most of the day: *Cirrostratus* and dew. 11—13. Fine breeze, varying to N and E: much dew; twilight, orange; and the moon pale. 14—22. Pretty strong breezes prevailed during this interval: the sky presented usually the *Cumulus* passing to *Cumulostratus;* but at intervals this modification took its character from *Cirrocumulus*, which entered into its composition from above. There was scarcely any *Cirrus* or obscurity above the clouds, but rather a cold, transparent blue: two or three times the density of the clouds promised showers, but it always ended in a very slight sprinkling. Coloured skies at sunset were frequent; as also the appearance of diverging bars of light and shade, which I ascertained in several instances to be due to the immense quantity of *dust* constantly floating in the air. 22. This morning, being gray with *Cirrocumulus* and very cool, seemed like the commencement of autumn; and the warmth of a fire was acceptable in a north room in the evening.

RESULTS.

Winds Southerly in the fore part; Northerly, with depression of temperature, in the latter part of the period.

Barometer:	Greatest height	30·27 inches.
	Least	29·80
	Mean of the period	30·051
Thermometer:	Greatest height	93°
	Least	43
	Mean of the period	63·32
Mean of the Hygrometer		45
Evaporation, nearly		4 inches.
Rain		0·14 inches.

A period unequalled in dryness since the beginning of 1810; when, with a frosty air, under a similar course of winds, and the barometer averaging 30·07 in. there fell in 30 days only 0·12 in. of rain.

TOTTENHAM, *Eighth Month*, 26, 1818. L. HOWARD.

ANNALS

OF

PHILOSOPHY.

OCTOBER, 1818.

ARTICLE I.

Biographical Account of M. Senebier.[*]

THE little republic of Geneva, which has afforded us so many topics for scientific biography, was the native place of the subject of this memoir. J. Senebier was born in this city in May, 1742; we have few particulars related respecting his parents; but it appears that they were persons of worth and respectability, and in that middle rank of life which, if not the most favourable for the development of extraordinary genius, seems to be the best adapted for the cultivation of the amiable qualities of the heart. He entered at an early period upon his studies in the college of Geneva, and was proceeding in them with success, when his father, who is described as a prudent man of business, obliged him to abandon his literary pursuits, and to enter upon a commercial occupation, from which he had himself derived considerable emolument, and which he wished to transfer to his son. The wishes of the elder Senebier were given in so decided a manner, that the young man obeyed without a struggle, he entered into his father's office, and appears for a time to have completely devoted himself to his altered plan of life. A year's initiation in his new employment does not, however, appear to have effected any radical change in his views or wishes; he still sighed in secret for a college life, regretted the time which he had been absent from his studies, and watched, with painful emotions, the progress which his late associates were making in their literary pursuits, in which he was no longer permitted to accompany them. In this state of mind he wrote a letter to his father, urgent, but respectful, in which he strongly painted his eager desire to resume his former occupations, when the father, with a degree of forbearance and discretion which is not very usual under such circumstances, allowed himself to be persuaded, and suffered his son to pursue the bent of his genius. The result was that young Senebier entered upon his college exercises with unusual ardour; and in a few months was able to rejoin the classes to which he had formerly belonged, notwithstanding the length of time that he had been absent from them.

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[*] The facts in this memoir are extracted from an elogé on M. Senebier by M. Maunoir, which was read before the Society of Arts in Geneva.

At the age of 17 he commenced the study of natural philosophy, which afterwards became his chief occupation; and about the same period he became connected with Le Sage, who, although 18 years older than Senebier, formed a strong attachment to him, which he ever afterwards retained. At the same time he went through a course of physiology under Tronchin, and became so much attached to the pursuit as to have been strongly inclined to devote himself entirely to the study of medicine. As, however, there appeared no prospect of his being able to exercise this profession at Geneva, he soon abandoned the idea; and after deliberating for some time between law and divinity, he finally decided in favour of the latter, and regularly entered upon his theological studies in his 19th year.

Senebier was ordained into the ministry in 1765, and shortly afterwards undertook a journey to Paris, with his expectations raised to the highest pitch of the scientific and literary gratification which he was to enjoy in that city. But, as his eulogist remarks, when he arrived in that immense capital, ignorant of the world, without experience and without a guide, the brilliant pictures of his imagination were quickly effaced. As, perhaps, must always be the case under similar circumstances, he thought the literary men less interesting than he had conceived them to be from the perusal of their works, complained that they were not communicative, and, after a very short residence in Paris, left it with his enthusiasm much diminished.

His first publication was a collection of moral tales, which appear to have been more remarkable for the pure and amiable spirit which they manifested than for their literary merits. He soon, however, entered upon the career in which he afterwards became eminent; and in consequence of the advice of Bonnet, to whom he was strongly attached, undertook, in 1768, to answer a prize question, proposed by the Haarlem Society, on the art of making observations. This essay was afterwards extended by him into a work occupying three volumes, and was published, after an interval of 30 years, in its new form, under the title of "An Essay on the Art of making Observations and Experiments."

In 1769, in his 27th year, Senebier married, and had the good fortune to unite himself with an amiable and excellent woman, of a disposition and turn of mind very congenial to his own. Nearly at the same time he was appointed pastor in the parish of Chancy, about nine miles from Geneva, which is described "as a delicious rural retreat, where every thing was in harmony with the state of his heart." In this situation he spent four of the most pleasant and useful years of his life, until in 1773 he quitted his rustic abode, and succeeded M. Lullin as the public librarian of Geneva. Soon after his appointment he undertook the task, in conjunction with M. Diodati, of forming a catalogue of the library, arranged according to the order of the subjects, a task which was completed in three years. About the same period he entered upon the study of chemistry, as a pupil of Prof. Tingry, and soon began to exercise his pen in discussing the merits of the doctrine of phlogiston, which was then becoming the great topic of controversy. It was also at this time that he undertook, at the request of his friend Bonnet, the translation of Spallanzani's "Opuscules de Physique végétale et animale."

In the year 1779 M. Senebier published his first memoirs on the influence of light, a subject in which he afterwards laboured with much attention, and is the topic on which he may be considered as having made the most important additions to our knowledge. His experimental career was stopped for some time by a severe illness, occasioned, as we are informed, by the grief which he experienced in consequence of the death of his father; but he embraced the first moments of his convalescence to resume his labours, when he particularly directed his attention to the green matter which is often formed in water exposed to the action of light. This had been conceived by some naturalists to be of animal origin; but Senebier clearly proved its vegetable nature, and determined it to be a conferva, affording a shelter or nidus for numerous insects, but in no way partaking of their properties. He resumed his researches into the action of light upon vegetables in the year 1782, and directly opposed the opinion that had been advanced by Ingenhousz, who conceived the action of leaves upon the air during the night to be deleterious. Probably in this instance neither of the opinions that were maintained are correct; but in the course of the discussion to which the controversy gave rise, Senebier made a series of important observations, which tended considerably to enlarge our knowledge on the subject of vegetation and the chemical change which this function produces on the air. There is so much uncertainty in the results of experiments on living vegetables, that after all the researches that have been made, there are comparatively but few points that can be considered as absolutely proved; but among these we may probably rank one of Senebier's discoveries, that when the leaves of plants are acted upon by the sun's rays, they absorb carbonic acid, decompose it, retain the carbon, and discharge the oxygen.

While Senebier was thus pursuing with so much assiduity his experiments on vegetable life, he was not inattentive to the progress of the other departments of chemical science. In 1784 he published his "Analytical Researches on the Nature of Inflammable Air;" he devoted a portion of his time to meteorological observations, successively translated the two works of Spallanzani on generation and on digestion, and at the same time he drew up "The Literary History of Geneva." In the year 1787, a periodical work was established under the title of "The Journal of Geneva," to which Senebier is stated to have been a very liberal contributor; and in the following year he undertook the more difficult and laborious task of writing the article Vegetable Physiology for the French Encyclopædia. On this work he probably thought it necessary to bestow a degree of minute attention which was not customary with him, so that it was two years in being completed. Shortly after this period, Geneva became involved in those political revolutions which convulsed the whole of Europe; and Senebier, who was little adapted, either by his disposition or his profession, for taking an active part in these turbulent transactions, retired into the country, where he remained, as it appears, in a state of complete seclusion, for nearly 10 years. Part of this time he employed in reprinting in an enlarged form his treatise on vegetable physiology, which appeared in 1800, extended to five octavo volumes. During the same period he translated Spallanzani's travels, and his work upon respiration: he contributed to the Journal de Physique, and other periodical works, a number of memoirs on various topics; but, for the most part, connected with vegetable physiology, and in conjunction with his friend Huber published an essay on germination.

This appears to have been one of the last of his published works; but in the list which is appended to the eloge, we find that a number were left in MS. and some of them of considerable size. His death was occasioned by a rheumatic affection of the left hand and arm, which terminated in a caries of the bones: amputation of the limb was had recourse to, but without success, as the operation was succeeded by a fatal hæmorrhage, which appeared to be connected with an ossification of the valves of the heart. He died at the age of 70 years, and left behind him the reputation of a man of great moral worth and much literary industry. After making all the reasonable deductions for the feelings of friendship which appear so conspicuously in the composition of his eulogist, we cannot doubt that Senebier was a person of the most amiable dispositions, and the most pure and upright intentions. He does not appear to have possessed much strength of character, although there is no circumstance recorded which would lead us to suppose that he manifested any remarkable deficiency in this respect, still less that he degenerated into any culpable weakness.

The same general remarks will apply to his scientific as to his literary character. There is a mildness and modesty which pervade his works, an obvious anxiety to arrive at the truth, a candour towards his opponents, and an air of good faith and simplicity, which cannot but produce a very favourable impression on the readers. On the other hand we must acknowledge that the stile is insufferably tedious and prolix, and that the information which they contain is so much diluted with common-place remarks as to make them altogether uninteresting in the perusal. His experiments are numerous, and were prosecuted with assiduity; but they are seldom of that description which can be stiled masterly or ingenious, but rather belong to the class which derive their merit from patient observation and frequent repetition. Upon the whole, however, the results are not very decisive, and can scarcely be regarded as affording an adequate compensation for the quantity of time which was devoted to them. Besides the works which have been mentioned in the course of this sketch, Senebier was the author of many other publications on various topics, as well as of a number of separate papers in different scientific journals. We apprehend that few of them will maintain their credit with posterity; they seem to be written without much care, and to be destitute of that fire of genius or brilliancy of language, which can give currency to hasty productions. In short, Senebier wrote too much to write well; and we may venture to assert that he would have been more useful to his contemporaries, and better entitled to the gratitude of posterity, if his works had been less bulky, but more correct.

ARTICLE II.

On the Combustion of Alcohol by the Lamp without Flame. By John Dalton, Esq.

(To Dr. Thomson.)

RESPECTED FRIEND, *Manchester, Aug.* 3, 1818.

On considering the phenomena of the lamp without flame continuing the combustion of alcohol by means of the coils of platina wire, it struck me as desirable to ascertain whether the products in this are the same as in the ordinary combustion; I was inclined to think that an imperfect or semi-combustion of the charcoal might, perhaps, be the result, and that carbonic oxide, rather than carbonic acid, would be found in a confined atmosphere subject to this operation.

About three months ago I suggested the above to Dr. Henry, when we immediately burned the lamp under a bell glass; and extracting a portion of the air, we were soon convinced by the ordinary tests that it contained carbonic acid. A few days afterwards I repeated the experiment with a view to find whether any carbonic oxide was mixed with the acid; the lamp was burned under a bell glass of 120 cubic inches till the redness of the wire ceased to be visible in the dark, when a phial of the air was extracted for examination; as soon as the bell glass was removed, the wire resumed its original glow again, which showed that the combustion had not ceased. On examining the air over mercury in the usual manner, I found it contained 14½ per cent. of oxygen and about four per cent. carbonic acid; but I could discover no more carbonic acid by firing the residue with the addition of hydrogen and a little oxygen.

Thus it appeared that my conjecture respecting the production of carbonic oxide was not supported by experiment; this kind of combustion proved to be rather more than less vigorous than the ordinary one, as the oxygen was reduced rather more than it would have been by the common combustion carried to extinction.

In order to examine this last point more fully, I caused the lamp to burn with flame under the same bell glass filled with atmospheric air, till it was extinguished spontaneously. The residuary gas was found to consist of 16½ per cent. oxygen, and three carbonic acid. Again, the lamp without flame was burned under the same glass in like circumstances, and kept for 40 minutes, when it was quite extinct; the residuary air being examined was found to contain only eight per cent. oxygen, and nearly the same quantity of carbonic acid.

I have frequently found on former occasions that the combustion of oil, wax, tallow, &c. all reduce the oxygen nearly in the same degree before the combustion is extinguished, namely, four, five, or six per cent. it being 21 per cent. at the commencement. It appears to me, therefore, a very singular and remarkable fact, that this species of combustion should be enabled to reduce the oxygen so much, or to support itself in circumstances in which the ordinary one entirely fails.

I remain, yours truly,
John Dalton.

Article III.

Observations on the Spiral as a Motive Power to impel Ships through the Water, with Remarks when applied to measure the Velocity of Water and Wind. By Col. Beaufoy, F.R.S.

(To the Editors of the *Annals of Philosophy.*)

GENTLEMEN, *Bushey Heath, July 22, 1818.*

In the Annals of Philosophy for last June, an ingenious plan *is given for impelling* vessels through the water with a spiral oar, and which Mr. Dick is of opinion might be usefully employed in propelling ships of war. A contrivance of this kind I saw, between 30 and 40 years past, in Switzerland, in the model of a flat-bottomed vessel, brought by Monsieur Bosset from the East Indies, but made in China; this model had underneath its bottom a spiral, which was turned when wanted with considerable rapidity by clock-work, put in motion by a spring similar to a watch; the vessel being placed in a tub full of water, the spring wound up, and the helm put over, more or less according as the tub was large or small, the boat continued running in a circle until the clock-work went down.

I witnessed an experiment on a much larger scale, made in Greenland Dock by Mr. Lyttleton, formerly a master in the Royal Navy. This gentleman had fixed to the stern-post of a Virginia pilot-boat, a frame containing a large copper spiral, which, by a winch, turned by two or more men, gave it a rotary motion; the effect was much less than expected; for notwithstanding the boat was completely empty, and considerable exertions used, the progressive velocity did not exceed the rate of two knots per hour.

As a perpetual log, the spiral * has been used, and found very useful in maritime surveying, by measuring a base line on the water. This method of finding the distances of one headland from another, is rendered useless, if the spiral be placed within a concave cylinder; for the friction of the water against the inside impedes its progress, consequently the distance shown by the perpetual log is less than the true. Being requisite that the number of revolutions made by the spiral be noted, it is most advantageously done by a line and clock-work, one end being attached to the log, the other to the clock; but as the friction of the clock-work, and the resistance the line meets with by revolving in the water, impede the rotary motion of the spiral, an allowance must be made for the error by placing the clock on board a vessel towed in a stagnant canal, and measuring with a perambulator, on the tract-path, the distance the vessel has moved, the difference of the space shown by the perambulator and the log is the error of the spiral; should the water have a slow motion, as is generally the case in our canals, the same distance should be measured both with and against the stream, and the mean of the two numbers of revolutions taken for finding the error.

The spiral may also be applied to measuring the velocity of the wind; and it is better in this case, as well as the former, to have two leaves, or a double spiral, each leaf making a half revolution, than a single worm, which makes a complete turn. Mr. William Cary, optician in the Strand, made me a machine of this

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* Invented by the celebrated Dr. Hooke.

kind. The accompanying drawing, fig. 1, represents the spiral, which consists of a double worm, *a a*, 20·8 inches in diameter,

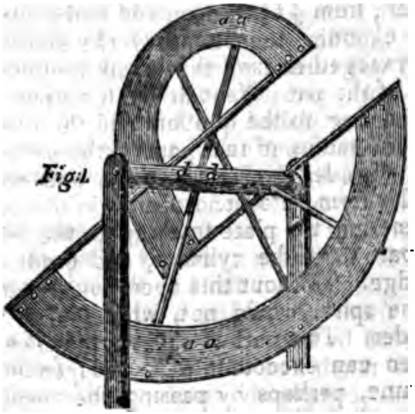

Fig. 1.

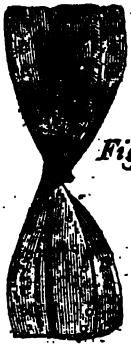

Fig. 2.

exclusive of the leaves, the cylinder *d d* round which it twines is $17\frac{1}{4}$ inches long; the parts *a a* are of brass, three inches broad; the clock-work (not represented in the drawing) consists of a pinion of 10 teeth fixed to the pivot of the axis *d d*, which gives motion to a contrate wheel of 40 teeth fixed to an upright axis passing in front of the frame; at the bottom of the upright axis is a small single thread worm, which turns a wheel of 50 teeth; on the axis of this wheel is fixed a long hand, which points out 200 yards in one revolution; on the other axis is placed a pinion of 10, which turns a wheel of 100, and shows, by a second but smaller hand 2,000 yards, or nearly one nautical mile; on the other axis of this wheel is also a pinion of 10 teeth, which communicates with another wheel of 100 teeth, and by another index, or third hand, shows 10 miles; on this axis, likewise, there is a pinion of 10 teeth, which turns another wheel of 100 teeth, and by an index, or fourth hand, points out 100 miles.

Fig. 2, represents a spiral log, the thick part of the machine is of wood, for the double purpose of floating and fastening the tin or copper leaves *c c*. If the spiral be truly made, and not resisted in revolving, it is evident it will make one revolution or half a revolution, whilst it moves through a space equal to the length of its axis, one revolution if the twist make a whole turn, half a revolution if the twist go only half round; for the resisting medium may be considered as a concave screw, and the spiral as a convex one running into the former. To cut a plate of metal the proper shape, it is necessary to have the dimensions of the cylinder round which the metallic plate is to be bent. The length of a spiral going half round the cylinder is equal to the square root of the sum of the squares of the cylinder's length, and half its circumference; and the diagonal of the cylinder is the chord of this circle. To calculate the radius sufficiently accurate for practical purposes, add to three times the length of the arc the diagonal of the cylinder; from $\frac{1}{8}$ of the sum add and subtract half the diagonal of the cylinder, then multiply the sum and difference of these numbers together, and the square root of the product is the versed sine of the arc. Next divide the square of half the chord by the versed sine, to the quotient add the versed sine, and half the sum is the radius of that part of the metallic curve next the cylinder. Besides giving the inner and outer edge of the metal a circular form, a second operation becomes necessary, which is hammering the plate to elongate the outer edge, beginning at the part next the cylinder, and gradually proceeding to the outer edge. Without this operation the metallic leaf which forms the spiral would not, when fixed, be perpendicular to the cylinder. This part of the work being so difficult that few workmen can execute it well, it depends on science to invent a machine, perhaps by passing the metallic leaf between conical rollers, which, by pressure, might supersede the necessity of hammering, and would render this instrument of more practical utility. In conclusion it must be remarked, that it was originally intended that the axis of the wind spiral should have measured 18 inches, but the difference, half an inch, was designed to allow for the friction of the machine and the resistance of the air to the radii. For the purpose of determining if half an inch was a sufficient allowance for the impediments the spiral met with when turning, an upright and revolving shaft was erected, from which projected an horizontal arm, to the extremity of which was fixed the frame of the wind spiral, the upright shaft being turned a given number of revolutions: the space the extremity of the arm moved, calculated and compared with the distance shown by the spiral, the difference was as 1000 to 779, that is, the spiral in moving 1000 yards gave the distance too small by 221 yards: a table being constructed, the true velocity may be had by inspection.

Trusting some of your readers will not deem the subject unworthy their consideration, I remain, Gentlemen,

Your obedient humble servant,

Mark Beaufoy.

Article IV.

Memoir relative to the Annular Eclipse of the Sun, which will happen on September 7, 1820. By Francis Baily, Esq.

(*Concluded from p.* 186.)

Having thus given a general outline of this eclipse, I shall proceed to state the principal phenomena which have been observed in former eclipses of this kind,* whereby the reader may be aware of the principal observations to which it will be proper for him to attend, and make his preparations accordingly. Many of these phenomena have given rise to much discussion, and are far from being accurately determined, or reduced to general principles. There is also a degree of doubt respecting the existence of some of them. Those persons, therefore, who are furnished with convenient instruments, and have a favourable opportunity, should carefully attend to, and note down, not merely the phases of the eclipse, but such other appearances as may present themselves. It is only by multiplying observations of this kind that we can ultimately arrive at the truth: and an annular eclipse is so rare an occurrence in this part of the globe, that it is hoped every advantage will be taken of it, to improve and advance the connected sciences of astronomy and geography.

There is one important observation, however, connected with this eclipse, which it is in the power of almost any competent person to make, without the aid of any particular instruments: I allude to the formation and dissolution of the annulus.† This may be determined very accurately, if not by the naked eye, at least with a telescope of *very small* magnifying power; ‡ furnished with a coloured glass to keep off the rays of the sun, or with a glass smoked in the manner hereinafter mentioned.§ The times of these phases may be determined with sufficient accuracy by means of a clock, or watch that beats seconds; and which should, if possible, be set to mean time on the day of the eclipse. The neglect of this precaution, however, should not prevent the observer from noting down the *duration* of the annular appearance; which will be the same, whether the watch is right or not.‖ As the method, therefore, of observing this phenomenon is so simple and easy, it is hoped that no person, to whom the opportunity may occur, will omit to note down the particulars; or fail to communicate the same to some person conversant with the subject of astronomy. It will be of equal importance to know that the existence of the annulus is only *momentary:* or even that it is *nearly,* but *not completely* formed.[*]

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* Those of 1737 and 1748. There are but few observations of the eclipse of 1764.

† The annulus is considered as completely *formed* when the whole body of the moon just appears on the disc of the sun, however unequal in breadth the uncovered part of the sun's disc may be. It is considered as *dissolved* the moment the moon again touches the concave circumference of the sun's disc. The *duration* of the annulus will not in any place, as already observed, exceed six minutes, and in some places will be momentary.

‡ A common opera glass might be made use of, if nothing better should present itself: as no method should remain untried for determining this very important phase. If the observer be near-sighted, and have not the advantage either of a telescope or concave glasses, he may view the sun through a small hole made in a card by means of a pin.

§ Those who cannot procure either coloured or smoked glass may view the image of the sun in a bucket of water, or a vessel filled with oil, placed in a situation where it may not be agitated by the wind.

‖ Should the observer be in such a situation as not to have the advantage of either a clock, or a watch beating seconds, he might easily make a temporary pendulum, of any convenient length, and notice the number of vibrations which it makes during the existence of the annulus. In such case, the length and substance of the pendulum should be specified.

Athough the possession of proper instruments must give a superior degree of credit to the observations of any person; yet I would not discourage those who have not this advantage from communicating any circumstances that may occur. For it has been justly observed by M. De L'Isle, that although no great dependance can be placed on those observations which are not made with a telescope, &c. yet that such observations as are made with the naked eye ought not to be entirely neglected; since it affords us an opportunity of judging of the accuracy of those observations which were made before telescopes, &c. were invented.

Those persons, however, who have the proper instruments, and every conveniency for observing, will of course note down the usual circumstances in such case: viz.

1. The time of the commencement of the eclipse.[†]
2. The time of the formation of the annulus.
3. The time of the dissolution of the annulus.[‡]
4. The time of the end of the eclipse.

If there should be any *spots* on the sun, it will be proper (previous to the commencement of the eclipse) to make a diagram of the sun's disc; and to note down the times when the body of the moon comes in contact with the spots, and likewise the times when they again become visible. All these may be determined with sufficient accuracy by the assistance of a telescope magnifying 30 or 40 times; together with a well regulated clock, or watch, that beats seconds; and which, if possible, should, as before observed, be set to mean time on the day of the eclipse.[*] I must again repeat, however, that the neglect of this precaution should not deter the observer from noting down the *duration* of the several phases above-mentioned, and particularly the times at which the *annulus* is *formed* and *dissolved*: which may be afterwards compared with more exact observations, and lead to a correction of the true times.[†]

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[*] To those who are not much conversant with practical astronomy, it may, perhaps, be proper to remark, that the more *numerous* these observations may be (that is, the greater the number of *places* where they are made), the more important will be the consequences to be derived from them. Consequently *every* observation will be material. Those persons who may observe the eclipse in the country should state the distance and position of such place from the nearest principal town.

[†] It is rather difficult to determine the *exact* time of the *commencement* of any solar or lunar eclipse; since the impression on the disc does not become visible till some seconds after the eclipse has begun. The field of the telescope should take in at least one half of the circumference of the sun's disc (taking that portion of it which may leave the expected point of contact in the centre), as the eye can much better judge of any impression made upon a large, than a small portion of a circle. In some cases, however, a *very powerful* telescope (which takes in only a small portion of the sun's disc) may be attended with advantage, as in the case of the solar eclipse on Sept. 5, 1793, where Sir Wm. Herschel observed that the first impression on the sun's disc was made by the projection of two high mountains of the moon, having the appearance of *horns;* which were distinctly visible on the sun's disc before the body of the moon appeared.—Phil. Trans. 1794, page 39.

[‡] In order to determine, with greater accuracy, the formation and dissolution of the annulus, the observer should take into his telescope that part only of the disc of the sun which is necessary for the purpose. By adopting this method Mr. Maclaurin, in 1737, was enabled to observe the appearance alluded to in page 254; and which preceded the perfect formation of the annulus about 20 seconds; thereby enabling him to look out *for and note* down the exact time with greater precision.

It is presumed that the observer will also, from time to time, during the progress of the eclipse, observe and note down the distance and inclination of the cusps in the usual manner.[‡] It may likewise be proper to remark that it will be of considerable importance to ascertain, at the time of the middle of the eclipse, the magnitude of the annulus on the north and on the south side of the moon, in order to determine how far distant, at that time, the centre of the moon is from the centre of the sun.[§] If at the same moment the observer can determine the diameter of the sun and moon, it will add considerably to the importance of the observation; and tend to determine a much disputed point in practical astronomy.[‖] These observations, however, should be made with a good telescope furnished with an accurate micrometer: and, in making a report thereof, the observer should describe the kind of telescope made use of, as well as the method employed in determining the magnitude of the annulus, &c. For the sake of greater accuracy, he should also make a diagram of the appearance of the sun and moon, at the time of the middle of the eclipse; placing a mark against that part of the sun's disc which appears the most vertical to him. The point on the circumference of the sun's disc (relative to its vertical or horizontal diameter) where the moon leaves it in order to form the annulus, and again where it touches it at the time of the dissolution of the annulus, should also, if possible, be distinctly noted. M. Le Monnier considers this of considerable importance.[*]

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[*] In the evening of the same day on which this eclipse takes place there will be an eclipse of the first satellite of Jupiter: the immersion will take place at Greenwich at $8^{h}\ 34'\ 34''$ mean time. Those persons, therefore, who are furnished with sufficiently powerful telescopes, may (if the weather prove favourable) have an opportunity of ascertaining the correctness of their clocks or watches.

[†] M. De L'Isle states, that if we observe the *situation* of the cusps, or only their distance, at the time of the middle of the eclipse (when the eclipse is not annular, but nearly so), it will serve to determine the apparent route of the penumbra and its limits, as exactly as if we had observed the duration of the annular eclipse.

[‡] There are two modes of observing the phases of an eclipse of the sun: the one, by looking directly at the sun, with a telescope furnished with a micrometer; the other, by receiving the image of the sun, through a telescope, on a screen, in a dark chamber, or *camera obscura*. Each has its advantages, and may be practised according to circumstances. See Lalande's Astronomie, vol. ii. p. 659. M. De L'Isle indeed says, that "we may determine, with sufficient exactness, the *situation* of the cusps, without making use either of the dark chamber or the micrometer, by observing the moment of the passage of the cusps and of the limbs of the sun, by means of simple wires placed in the focus of the telescope, in any situation whatever; and leaving the telescope in a fixed position, during the time that the sun employs to traverse the field of it."

[§] M. De L'Isle doubts whether this part of the observation can be made with sufficient accuracy in a dark chamber; on account of the indistinctness of the image of the moon.

[‖] See next page.

It was observed, in the annular eclipse of 1737, that the annulus was formed and dissolved very *suddenly*. For when the whole body of the moon had entered on the disc of the sun, the last portion that entered appeared to adhere to the concave circumference of the sun's disc for some seconds; and the moon appeared elongated on that side, till the sun's light suddenly broke round it, when the moon reassumed its regular curvature. In a similar manner, when the disc of the moon approached the concave line of the sun's disc on the other side, they seemed to run together like two contiguous drops of water on a table when they touch each other.

It was also observed, in the eclipse of 1737, "that as the annulus was forming, the light appeared to break in several irregular spots near the point of contact: and that the limb of the moon seemed to be indented there." These irregular parts seemed likewise to have a kind of motion; although there was no undulation at the same time in the circumference of the sun. Such appearances of a tremulous motion, in certain periods of solar eclipses, are mentioned by Hevelius and others. It was noticed also in the eclipse of 1748.[†]

In both these eclipses, as well as in that of 1764, it was observed, that when the annulus was formed, the moon appeared much *smaller* on the sun than it really ought to be; and indeed much smaller than the calculations seemed to warrant. But whether this phenomenon arises from an apparent enlargement of the sun's disc, or from an apparent diminution of the moon's disc, or from both, does not seem clearly decided. M. Du Séjour has discussed this subject, with his usual ability, in his *Traité analytique des Mouvemens apparens des corps célestes*, vol. i. page 405, &c.; but he has not come to any precise determination thereon. The observations have not been made with sufficient accuracy, nor are they sufficiently numerous to enable us to determine so nice an element in the calculation of eclipses.

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[*] In his paper *Sur l'Utilité des Eclipses de Soleil* (wherein he has drawn many important conséquences from the eclipse of 1748) he remarks, respecting the method of determining the limits of the umbra, that "la plupart des observateurs, en pareil cas, suivent les routes ordinaires, et n'ont jamais fait assez d'attention au point de la circonférence du limbe du soleil où se forment les ruptures de l'anneau: désormais ces points de la circonférence du disque du soleil seront les plus importans, et nous fourniront les limites que nous voudrons bien assigner."—Mem. de l'Acad. des Sciences for 1765, p. 463.

[†] The Rev. Mr. Irwin, who noticed the eclipse of 1748 at Elgin, says that "the formation and breaking of the annulus were sensibly to be observed, and passed *in a moment;* affording a very pleasing sight by the irregular tremulous spots of the sun."—Phil. Trans. vol. xlv. p. 595.

It is hoped, therefore, that the attention of astronomers will be more drawn towards this subject in the ensuing eclipse.*

In the eclipse of 1737, Maclaurin observes that about 20 seconds " before the annulus was complete, a remarkable point or speck of pale light appeared near the middle of the part of the moon's circumference that was not yet come upon the disc of the sun; and a gleam of light, more faint than that point, seemed to extend from it to each horn."

In the eclipse of 1748, it was noticed that there was " about the middle of the eclipse, a remarkably large spot of light, of an irregular figure, and of a considerable brightness, about seven or eight minutes within the limb of the moon." Mr. Short states that this eclipse was not quite annular at Aberdour Castle: "the cusps seemed to want about $\frac{1}{7}$ of the moon's circumference to be joined, yet a brown light was plainly observed both by my Lord Morton and myself to proceed or stretch along the circumference of the moon, from each of the cusps, about $\frac{1}{3}$ of the whole distance of the cusps from each cusp; and there remained about $\frac{1}{3}$ of the whole distance of the cusps not enlightened by this brown light."—" I observed at the extremity of this brown light, which came from the western cusp, a larger quantity of light than in any other place, which at first surprised me; but afterwards I imagined it must have proceeded from some cavity or valley made by two adjoining mountains on the edge or limb of the moon. I had often formerly observed mountains on the circumference of the moon, more or less every where round it, but never saw them so plain as during the time of this eclipse. The mountainous inequalities on the southern limb of the moon were particularly remarkable; in some parts mountains and valleys alternately; others extended a considerable way along the circumference and ended almost perpendicularly like a precipice. My Lord Morton was able to see them very easily through his small reflector."

The King of France, who (as already mentioned) went purposely to Compiegne to observe this eclipse, discovered towards the middle of the eclipse (which was not more than $9\frac{1}{2}$ digits) " sur la surface de la lune, comprise entre les cornes du soleil, des rayons de lumière rouges, et un filet de lumière qui sembloit masquer le disque de la lune, et qui s'étendoit à une distance des cornes.† "

M. De L'Isle, in his publication above alluded to, seems to think that a quick eye, guarded with a sufficiently dark glass, might, in solar eclipses, discover the body or limb of the moon seven or eight minutes before it touched the sun, and also for the same time after it had left it and was entirely off the sun. He remarks that the observer should defend himself as much as possible from the direct light of the sun, and also from the light of the external air. No person, however, has hitherto noticed such an appearance; although many observers attended particularly to it, in the eclipse of 1748, in consequence of M. De L'Isle's remarks. Should the moon in such case ever be visible, it would enable us to determine with greater accuracy the commencement of any solar eclipse.*

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* See Lalande's Astronomie, vol. ii. p. 445; Delambre's Astronomie, vol. ii. p. 423; and also M. Le Monnier's memoir *Sur les Eclipses totales du Soleil*, in the Mem. de l'Acad. des Sciences for 1781, p. 243. In this memoir there is a map of the path of the moon's umbra in the total eclipse of May 22, 1724, and which appears to have proceeded over great part of England: nevertheless I cannot find any observation of it in this country.

† Mem, de l'Acad. Roy. des Sciences, 1748, p. 56.

During the progress of the eclipse it would be desirable to ascertain the degree of cold and obscurity caused by the diminution of the sun's rays; for which purpose preparations should be made before-hand, in order that no time be lost during the period of the eclipse. The variations in the thermometer and barometer may be easily noted down without interrupting the astronomical observations. The rapid change in the temperature of the air may cause a hurricane of wind (together with rain or snow), as was observed about the middle of the eclipse by Mr. Maclaurin in 1737; and by Le Monnier in 1748. Mr. Short says, that (in the eclipse of 1748) "we did not at all perceive or feel any greater degree of cold, during the eclipse, than we felt before it began." But M. Cassini De Thury, who went with the King of France to Compiegne to observe this eclipse, and where it was only 9¼ digits, says, they experienced a considerable degree of cold at the time of the middle of the eclipse; the thermometer, however, fell only 2½°: and the Abbé Nollet found that his burning-glass was then as powerful as before the eclipse began. M. De L'Isle, likewise, who observed this eclipse at the Luxembourg, remarks, that the thermometer did not indicate any increase of cold caused by the eclipse, although he and many other persons experienced it soon after the middle of the eclipse.†

In the eclipse of 1737, Maclaurin observed that a burning-glass which kindled tinder and burned cloth towards the end of the eclipse, had no effect during the existence of the annulus, nor for some time before and after it. He likewise remarked, that "during the appearance of the annulus, the direct light of the sun was still very considerable; and that although some places that were shaded from his light appeared gloomy, yet that the day-light was not greatly obscured." He adds, that many persons, about the middle of the annular appearance, although not short-sighted, were unable to discover the moon upon the sun when they looked without a smoked or coloured glass.[*] Nevertheless Venus and some other stars were visible at the same time; and Venus continued visible even after the annulus was dissolved. Venus was also seen in the eclipse of 1748, but it does not appear that any other star was then visible.

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* It must be evident to the practical astronomer, that if the moon were really visible in such cases, she would also be frequently visible at the conjunctions, when no eclipse took place. M. De L'Isle's suggestion arose from a remark made by M. Cassini on a luminous ring which was seen to surround Mercury in its passage across the sun's disc in the year 1736, and which continued for six or seven seconds after Mercury was entirely off the sun's disc. See Mem. de l'Acad. des Sciences for 1736, p. 373.

† In the total eclipse of 1724 the thermometer had fallen only two degrees at the time of the middle of the eclipse. This is the more remarkable as the eclipse took place late in the afternoon of May 22, at which time we might presume that the atmosphere would be gradually becoming more cool. The total darkness took place at 6h 48′ p. m.

If the diminution of light should be considerable (which there is not much reason however to suspect,[†]) Mercury, Venus, and Mars, together with some of the principal fixed stars, may be visible to the naked eye. Mercury, if visible, will be seen about 18° to westward of the sun, nearly in conjunction with *Regulus*: Venus will be about 41° to westward of the sun:[‡] and Mars about 35° to eastward of the sun, not far from *Spica Virginis*. The observer should also look out for any comet which may be visible during this eclipse; and be prepared to measure its distance from the sun or a principal fixed star.

As many persons may be so situated as not to be able to procure any dark-coloured glass, for the purpose of viewing the sun, I shall conclude this memoir by inserting Dr. Maskelyne's method of *smoking* glasses, which he published in the Nautical Almanac for 1769, in his *Instructions relative to the Observation of the Transit of the Planet Venus over the Sun's Disc* in that year.

"Dark glasses should be used to defend the eye from the intensity of the sun's light. Transparent glasses, smoked over the flame of a candle or lamp, will give a more distinct and agreeable vision of the disc of the sun than any tinged or coloured glasses will do. Provide two pieces of glass of convenient length, not too thick (the common crown glass, used for windows, will do as well as any), wipe them clean and dry.

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[*] M. Le Monnier mentions the same thing of himself in the eclipse of 1748.

[†] In the annular eclipse of 1764 an ignorant country clergyman alarmed the people of France by announcing that there would be *total darkness* during the existence of the annulus; and the Royal Academy of Sciences at Paris thought proper to give this report a formal contradiction. It is well known, however, that the smallest ray of light from the sun would prevent such a phenomenon; as I have shown more at length in my paper "On the Solar Eclipse which is said to have been predicted by Thales," inserted in the Phil. Trans. for 1811, part ii. p. 220.— I shall here take the opportunity of correcting a typographical error in that paper; where, in page 240, line 22, "three *degrees*" should be "three *minutes*." Since the publication of that paper, I find that the *Bureau des Longitudes* in France have printed a Supplement to M. Burgh's Lunar Tables, wherein the mean epoch and mean motion of the Supplement of the Node are considerably altered: so as to bring the latitude of the moon within the limits which I there suggested.

[‡] In the total eclipse of 1715, Venus was seen when only nine digits were eclipsed: but she was not seen at Compiegne in the eclipse of 1748, although the digits eclipsed were 9½: in the eclipse of 1724, however, she was distinctly visible when only six digits were eclipsed. This is not remarkable, as she is, in some situations, visible even at mid-day.

Warm them a little by the fire (if the weather be cold) to prevent their cracking when applied to the flame of the candle: then draw one of them gently, according to its whole length, through the flame; and part of the smoke will adhere to the glass. Repeat the same operation, only leaving a little part at one end now untouched; repeat the operation, leaving a further part at the same end untouched, and so each time leave a further part of the same end untouched, till at last you have tinged the glass with several dyes, increasing gradually in blackness from one end to the other. Smoke the other glass in like manner, and apply the two glasses, one against the other, only separated by a rectangular border, cut of brass or card paper, the smoked faces being opposed to each other, and the deepest tinges of both placed together at the same end. Tie the glasses firmly together with waxen thread, and they are ready for use. The tinge at one end should be the slightest possible, and at the other end so dark that you cannot see the candle through it. By this contrivance, applied between your eye and the sun, you will have the advantage not only of seeing the sun's light white, according to its natural colour, and his image more distinct than through common dark glasses, but also of being able to intercept more or less of his light as you please, and as the clearness or thickness of the air requires it, by bringing a darker or lighter part of this combined dark glass before your eye; which will be a great convenience at all times, but particularly when the brightness of the sun is liable to sudden changes from flying clouds."

I shall merely add, that it is to be hoped the Sovereigns of the different provinces and states, mentioned in this Memoir (page 184), will encourage persons from the neighbouring countries to enter and observe this eclipse: and that the love of science will induce them to prevent such persons from being subject to any tarif, or vexatious delay at the Custom-house, on account of any astronomical or philosophical instruments which they may take with them for the purposes of observation.

ARTICLE V.

Researches on various Fatty Bodies, and particularly on their Combinations with Alkalies. By M. Chevreul.

(*Concluded from* p. 199.)

M. Chevreul's Sixth Memoir.[*]

The subject of this memoir is the different kinds of fat; particularly that of man, of the sheep, the ox, the jaguar, and the goose. Before he enters upon the proper topic of this memoir, the author takes a review of what he has done in the five preceding papers. He observes that in the first he described a body, which unites the characteristic properties of acids to all the generic properties of the fats and oils. This body, which he has named margarine, has served as the type of a new kind of ternary acid, and bears the same relation to the oxygenated vegetable acids as the hydrogenated do to the oxygenated acids in the inorganic kingdom.

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[*] Abstracted from Ann. de Chim. et de Phys. ii, 339. (Aug. 1816.)

The object of the second memoir was to analyze the products of the saponification of hog's-lard as effected by potash. After having deprived the soap of its margarine, a fatty body was obtained from it which was denominated *fluid fat*. This body, like margarine, unites to potash in two proportions, but it differs from it in fluidity, and in the solubility in cold water of its saturated combination with alkali. The examination of the fluid from which the soap is separated has shown that in saponification a sweet principle is produced, similar to that which Scheele observed in water, in which olive oil has been treated with protoxide of lead. These researches then have established that soap, which had been regarded as a compound of a fatty matter and an alkali, is really a double compound of alkali and of two fatty acid bodies.

The composition of soap being thus determined, in the third memoir the following facts were established: 1. That the essential products of saponification are margarine, the fluid fat, and the sweet principle; but that the odorous and colouring principles found in many soaps appear to be accidental: 2. That oxygen gas is not necessary for saponification: 3. That saponified fat is formed of margarine and of the fluid fat, and consequently possesses acidity: natural fat is formed of two new proximate principles, one of which is analogous to tallow, and the other to the liquid oil of vegetables; but both of these principles differ from those of saponified fat; for instead of being acid, they rather appear to possess an alkaline nature: 4. The experiments have also shown that the saponification of hog's-lard depends upon two causes that are inseparable; first, upon the elementary composition of this fat, which is such, that it may be represented either by the two immediate principles which constitute it, or by the sweet principle, margarine, and the fluid fat; secondly, upon the sweet principle, and still more the margarine and the fluid fat, having an affinity for potash much superior to the immediate principles of fat for the same base, from which it results, that in saponification the potash determines the fat to be converted into the sweet principle and the two acid substances. This total conversion of an organic matter into many substances, which are themselves compounds, and very different from the matter itself, may explain many phenomena in physiology, where bodies assume forms totally different from those which they previously possessed.

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In the fourth memoir, saponification was examined under two relations; 1. Under that of the bases which form it; 2. Under that of the quantity of alkali necessary to saponify a certain quantity of fat. The first inquiry, by showing that barytes, strontian, lime, oxide of zinc, and protoxide of lead, cause fat to undergo the same change that it does with potash and soda, has enabled us to generalize saponification, by proving that this operation depends upon an alkaline force which overcomes the obstacle which the cohesion of some bases and the insolubility of others seem to oppose to the change of fat into the sweet principle and the oily acids. The second inquiry, by showing that we can effect the saponification of a given weight of fat, merely by employing the quantity of alkali which is exactly necessary to neutralize the margarine and the fluid fat, into which this weight of fat can be converted, has formed a determinate basis for the art of the soap-maker. In this memoir, likewise, the capacity of the saturation of margarine has been exactly determined, and all the analyses of the soaps of this substance have shown that 100 parts of it saturate a quantity of base containing three parts of oxygen. There appears then to be a perfect analogy between margarine and the acids, so as to confirm the opinion of its nature which had been advanced in the preceding memoirs.

The crystallized matter of the human biliary calculus, spermaceti, and the adipocire of carcasses, had been confounded together under the same species of fatty matter; and the object of the fifth memoir was to show that this opinion is erroneous. The biliary calculus and spermaceti possess the characters of pure proximate principles, whilst adipocire, which is formed of margarine, of fluid fat, and of an orange coloured principle, possesses all the properties of a saponified fat. On the other hand, biliary calculus differs essentially from spermaceti, as the latter is perfectly saponified under circumstances in which the first absolutely resists the action of alkalies. The soap of spermaceti contains two oily acids, one of which only has been examined; it is in its general characters analogous to margarine and the fluid fat, but is distinguished from them by possessing only about half as much capacity for saturation.

The knowledge of the immediate principles which compose the different kinds of fats and oils accounts for the different degrees of fluidity of their compounds, but it does not explain the differences in colour and odour which many of them present. The discovery of the cause of these differences gives rise to a new order of facts, which will form the subjects of the succeeding memoirs. In the present memoir, the sixth, M. Chevreul proposes to examine the fat of man, of the sheep, the jaguar, and the goose; and to determine how far the proximate principles of these fats, and the oily acids which they are capable of producing, resemble those of hog's-lard.

The author remarks that he has hitherto made use of periphrases when speaking of the different bodies that he has been describing, as supposing that their nature was not sufficiently determined. He now, however, conceives that he may apply specific names to them, which will both be more commodious, and, at the same time, by being made appropriate, will point out the relation which these bodies bear to each other. The following is the nomenclature which will be hereafter adopted. The crystalline matter of human biliary calculi is named *cholesterine*, from the Greek words χολη bile, and ϛερεος solid; spermaceti is named *cetine*, from κητος, a whale; the fatty substance and the oily substance, described in the third memoir, are named respectively *stearine* and *elaïne*, from the words ϛεαρ fat, and ελαιον oil; margarine and the fluid fat are named *margaric acid* and *oleic acid*, while the term *cetic acid* is applied to what was named saponified spermaceti. The *margarates, oleates*, and *cetates*, will be the generic names of the soaps or combinations which these acids are capable of forming by their union with salifiable bases.

The author begins his examination of the different kinds of fat by giving an account of the different properties which they exhibit in their entire undecomposed state.

Two portions of human fat were examined, one taken from the kidney the other from the thigh; after some time they both of them manifested a tendency to separate into two distinct substances, one of a solid and the other of a fluid consistence; the two portions differed in their fluidity and their melting point. These variations depend upon the different proportions of stearine and elaïne; for the concrete part of fat is a combination of the two with an excess of stearine, and the fluid part is a combination with an excess of elaïne. The fat from the other animals was then examined, principally with respect to their melting point and their solubility in alcohol; the melting point was not always the same in the fat of the same species of animal. When portions of the fat of different sheep are melted separately at the temperature of 122°, in some specimens the thermometer descends to 98·5° and rises again to 102°, while in others it descends to 104°, and rises again to 106°. A thermometer plunged into the fat of the ox melted at 122°, descended to 98·5°, and rose again to 102°. When the fat of the jaguar was melted at 104°, the thermometer descended to 84°, and rose again to about 85°; but a considerable portion of the fat still remained in a fluid state. With respect to the solubility of the different kinds of fat in alcohol, it was found that 100 parts of it dissolved 2·48 parts of human fat, 2·26 parts of sheep's fat, 2·52 parts of the fat of the ox, 2·18 parts of the fat of the jaguar, and about 2·8 parts of the fat of the hog.

M. Chevreul next examines the change which is produced in the different kinds of fat respectively by the action of potash. All the kinds of fat are capable of being perfectly saponified, when excluded from the contact of the air; in all of them there was the production of the saponified fat and the sweet principle; no carbonic acid was produced, and the soaps formed contained no acetic acid, or only slight traces of it. The saponified fats had more tendency to crystallize in needles than the fats in their natural state; they were soluble in all proportions in boiling alcohol of the specific gravity of ·821. The solution, like that of the saponified fat of the hog, contained both the margaric and the oleic acids. They were less fusible than the fats from which they were formed; thus when human fat, after being saponified, was melted, the thermometer became stationary at 95°, when the fluid began to congeal; in that of the sheep the thermometer fell to 118·5° and rose to 122°; in that of the ox it remained stationary at 118·5°; and in that of the jaguar at 96·5°.

The saponified fat of the sheep and the ox had the same degree of solubility in potash and soda as that of the hog.

100 parts of the fat of the sheep when saponified were dissolved by	15·41 of potash.
100 parts of the same were dissolved by	10·27 of soda.
100 parts of the saponified fat of the ox were dissolved by.	15·42 of potash.
100 parts of the same were dissolved by	10·24 of soda.
100 parts of the saponified fat of the hog were dissolved by.	15·04 of potash
100 parts of the same were dissolved by	10·29 of soda

There is no carbonic acid necessarily produced in the saponification of the different kinds of fat; for if we take two equal quantities of the same solution of potash, and employ one of them in the saponification of any species of fat, if we then decompose the soap by the hydrochloric acid, we shall obtain a quantity of carbonic acid equal to that which is contained in the alkali that has not been employed in saponification. In order to discover whether any acetic acid is produced in the saponification of the fat of the human subject, of the sheep, and of the ox, 308·88 grs. (20 grammes) of each of these kinds of fat were saponified by pure potash; the soap was decomposed by tartaric acid; the aqueous fluid was poured off and distilled, the product was then neutralized by barytic water, and this was evaporated to dryness in order to obtain the saline residuum. The saline residuum from human fat was too minute to be sensible to the balance; it was observed that the aqueous fluid which proceeded from the decomposition of a soap prepared from the fat of the kidneys, and likewise from a soap prepared with the fat from the breast of a female, had a strongly marked odour of cheese, a circumstance which indicates the presence of the aroma of butter in these kinds of fat; this principle is not, however, found in all the specimens of human fat, that from the thigh being entirely without it.

The saline residuum obtained from the soap of mutton fat weighed ·06 gr.; but it seemed to contain a small portion of the sweet principle. By adding phosphoric acid, a rank odour was disengaged, mixed with that of acetic acid. The saline residuum of the soap from the fat of the ox was in too small a quantity to be appreciated, yet the aqueous fluid proceeding from the decomposition of the soap was acid and amber coloured; the odour was precisely the same with that which is disengaged from oxen, when they have been heated by exercise. The odorous principle is more developed in the fat of the jaguar by being saponified; the odour is not easily defined, but is thought to resemble that which is sometimes perceived in the menageries of wild beasts. From these observations we may conclude, that the action of potash develops in the fat of the sheep, the ox, and even of the jaguar, odorous principles, which are analogous to, if not absolutely identical with, those which the animals exhale under certain circumstances, and that an acid property accompanies these principles.

The following table contains the proportions of the saponified fat and of the matter soluble in water into which 100 parts of the fat are capable of being changed.

Human fat.	
Saponified fat	95
Soluble matter	5

Fat of the sheep.	
Saponified fat	95·1
Soluble matter	4·9

Fat of the ox.	
Saponified fat	95
Soluble matter	5

Fat of the hog.	
Saponified fat	94·7
Soluble matter	5·3

The quantity of soluble matter in these cases was obtained by calculation from the weight of the saponified fat, because it was not possible to separate completely the former from a portion of water and saline matter which was combined with it. Thus the syrupy fluid, which contained the sweet principle produced by saponification, although evaporated until it began to be volatilized, always weighed more than the fat had lost of soluble matter; for example, the syrup obtained from human fat weighed 9·4, that from sheep's fat weighed 8, while that from the fat of the ox and the hog each weighed 8·6.

M. Chevreul next proceeds to a particular examination of the *soaps of fat* and potash. The following was the method of analysis which was adopted: the soap, after being separated from the mother-water, was dissolved in boiling water: by cooling and rest a quantity of pearly matter was deposited, which is considered as a super-margarate of potash, and the fluid becomes alkaline. It was filtered and neutralized by tartaric acid; by rest there was a new product of super-margarate, and a quantity of alkali was set at liberty; the same process as that employed above was repeated until there was no longer a pearly deposit; an oleate of potash was then obtained, which was decomposed by tartaric acid. By this process the soap was reduced to the super-margarate of potash and the oleic acid. Our next object is to examine the relative proportion of these two ingredients as procured from the different kinds of soap. The super-margarates were first very carefully prepared by frequent ablution in distilled water and in alcohol, and they were then decomposed by the hydrochloric acid in the manner that has been described above as applied to the soap of hog's-lard: the following results were obtained:

Super-margarate of human fat.

Margaric acid.....	91·8848	100·00
Potash	8·1151	8·85

Super-margarate of the fat of the sheep.

Margaric acid.....	92·012	100·00
Potash	7·988	8·68

Super-margarate of the fat of the ox.

Margaric acid.....	91·925	100·00
Potash	8·075	8·78

Super-margarate of the fat of the jaguar.

Margaric acid.....	92·075	100·0
Potash	7·925	8·6

Super-margarate of the fat of the goose.

Margaric acid.....	91.94	100·00
Potash	8·06	8·77

The super-margarate of the fat of the hog is composed of 100 parts acid and 8·8 parts of potash, so that all these super-margarates are analogous in their composition.

Equal proportions of water and of these super-margarates were boiled together to observe whether they were acted upon in a similar manner; and the principal difference that was perceptible was the greater or less degree of semi-transparency of the solutions. The super-margarate from the ox was less opaque than that from the sheep, and this was less than that from the hog. It is stated that a mixture of one part of this last super-margarate with 10 of boiling water seemed to lose its transparency upon the addition of 18,190 parts of water; from which it might be inferred that a great mass of this fluid, at the boiling temperature, may dispose the super-margarate to be reduced to the neutral margarate and the margaric acid.

Boiling alcohol of the density of ·832 dissolves the super-margarates in all proportions, when they do not contain any margarate of lime. The following experiment may be cited as an illustration of this property: 20 parts of alcohol dissolve 50 of the super-margarate of the ox at the temperature of 140°; the alcohol was then so far concentrated that the fluid was to the super-margarate as one to six, yet no precipitate was formed.

If we compare the acids of the different super-margarates together, we shall find that they are all of a brilliant white colour, insipid, nearly without odour, insoluble in water, and soluble in all proportions in boiling alcohol. Their saturated combination with potash is soluble in boiling water, and by cooling is reduced to potash and an insoluble super-margarate. The differences which they exhibit consist in their fusibility, and in the disposition and size of the needles which are formed when the margaric acid is suffered to cool on the surface of water. The following is a more particular account of each of the individual acids.

The margaric acid of man was obtained under three different forms; 1. In very fine long needles, disposed in flat stars; 2. In very fine and very short needles, forming waved figures, like those of the margaric acid of carcasses; 3. In very large brilliant crystals, disposed in stars perfectly similar to the margaric acid of the hog. The thermometer plunged into these last crystals in a state of fusion, sunk to 133·5°, and rose again to 134°; the first crystals melted at about 132°.

The margaric acid of the sheep, when procured from the first deposit of super-margarate which was formed in the soap, was in the form of fine radiated needles; the thermometer plunged into it when fused, sunk to 139°, and rose again to 140°. The acid which was procured from the last deposits of super-margarate, crystallized in larger needles than the preceding, and melted at 132·5°. *The margaric acid of the ox* crystallized in small radiated needles; when it became solid, the thermometer rose from 139° to 140°. *The margaric acid of the jaguar* crystallized in small radiated needles; it was fusible at 131·5°. *The margaric acid of the goose* crystallized in beautiful brilliant, narrow laminæ, like the margaric acid of the hog; it melted at 131°. From this statement we perceive that the margaric acids of the ox and the sheep resemble each other the most nearly, as well in their form as in the degree of their fusibility, that we may obtain the acids of the human subject and the hog so as to exhibit similar properties, and that the acids of the jaguar and the goose very nearly resemble them. The greatest difference in the degree of fusibility is 9°.

We next proceed to the consideration of the oleic acid. M. Chevreul's experiments on the oleate of barytes, in order to determine the proportion of its elements, have finally induced him to adopt the quantities of 100 parts of acid to 27 parts of base as the most correct, and from these we conclude that 100 parts of the acid will neutralize a quantity of base that contains 2·835 parts of oxygen. This determination of the capacity of saturation of the oleic acid is further confirmed by the oleate of strontian and the sub-oleate of lead. The following table contains the proportions in which barytes, strontian, and lead, combine with the oleic acid.

Oleic acid of human fat.

	Barytes.	Strontian.	Lead.
Acid	100·00	100·00	100·00
Base	26·00	19·41	82·48

Oleic acid of the fat of the sheep.

Acid	100·00	100·00	100·00
Base	26·77	19·38	81·81

Oleic acid of the fat of the ox.

Acid	100·00	100·00	100·00
Base	28·93	19·41	81·81

Oleic acid of the fat of the goose.

Acid	100·00	100·00	100·00
Base	26·77	19·38	81·34

Oleic acid of the fat of the hog.

Acid	100·00	100·00	100·00
Base	27·00	19·38	81·80

M. Chevreul next gives an account of the analysis of fat by alcohol. He observes that he has found it very important in the prosecution of his experiments to employ alcohol of the specific gravity of from 0·791 to 0·798, instead of an alcohol of 0·821, which he had employed in his earlier experiments, because the solvent power of alcohol over fatty bodies diminishes in an extremely rapid progression when it is combined with water, and particularly from the specific gravity of ·795 to ·821. In proof of this position the following experiments are adduced: 100 parts of boiling alcohol, of the specific gravity of ·7908, dissolved 100 parts of the stearine of the sheep, and the solution was not saturated; 100 parts of boiling alcohol, of the specific gravity of ·7952, dissolved 16·07 of the same stearine; 100 parts of boiling alcohol, of the specific gravity of ·805, dissolved 6·63 parts, while 100 parts of boiling alcohol, of the specific gravity of ·821, dissolved only two parts.

The method of analysis employed was to expose the different kinds of fat to boiling alcohol, and to suffer the mixture to cool; a portion of the fat that had been dissolved was then separated in two states of combination; one with an excess of stearine was deposited, the other with an excess of elaïne remained in solution. The first was separated by filtration, and by distilling the filtered fluid and adding a little water towards the end of the operation, we obtain the second in the retort, under the form of an alcoholic aqueous fluid. The distilled alcohol which had been employed in the analysis of human fat had no sensible odour; the same was the case with that which had served for the analysis of the fat of the ox, of the hog, and of the goose. The alcohol which had been employed in the analysis of the fat of the sheep had a slight odour of candle-grease.

Examination of the alcoholic aqueous fluids. *That from human fat* exhaled an odour of bile similar to what was perceived from the fat of the hog; it produced a bitter yellow extract: the part procured from the first washing was alkaline, that from the last was acid; it also contained a trace of empyreumatic oil. That from *the fat of the sheep* did not exhale the odour of bile, but it produced an acid extract similar to the preceding. That from *the fat of the ox* was red and alkaline; it contained a little muriate of potash and muriate of soda. That *from the jaguar* had a disagreeable odour; it contained a yellow, bitter, oily matter, and it was thought also a little acetic acid. That *from the goose* only contained a trace of matter soluble in water, and was completely without smell.

The varieties of stearine from the different species of fat were found to possess the following properties. They were all of a beautiful white colour; entirely, or almost without odour, insipid, and having no action upon litmus.—*Stearine from man.* The thermometer which was plunged into it when melted fell to 105·5°, and rose again to 120°. By cooling the stearine crystallized in very fine needles the surface of which was flat.—*Stearine of the sheep.* The thermometer fell to 104°, and rose again to 109·5°; it formed itself into a flat mass; the centre, which cooled more slowly than the edges, presented small and finely radiated needles.—*Stearine of the ox.* The thermometer fell to 103°, and rose again to 111°; it formed itself into a mass, the surface of which was flat, over which were dispersed a number of minute stars visible by the microscope; it was slightly semi-transparent.—*Stearine of the hog.* It exhaled the odour of hog's-lard when it was melted. The thermometer fell to 100·5°, and rose again to 109·5°. By cooling, it was reduced into a mass, the surface of which was very unequal, and which appeared to be formed of small needles. When it cooled rapidly, the parts which touched the sides of the vessel had the semi-transparency of [illegible] albumen.—*Stearine of the goose.* The thermo- [illegible] 4°, and rose again to 109·5°; it was formed into

With respect to the solubility of these different bodies in alcohol, 100 parts of boiling alcohol, of the specific gravity of 0·7952, dissolved

Of human stearine	21·50 parts.
Of the stearine of the sheep	16·07
Of the stearine of the ox	15·48
Of the stearine of the hog	18·25
Of the stearine of the goose	36·00

Saponification by potash.

The human stearine produced by saponification.	Saponified fat.	94·9	It was fusible at 123·5°; it crystallized in small needles joined in the form of a funnel.
	Soluble matter.	5·1	The syrup of the sweet principle weighed 8·6; the acetate 0·3.*
Stearine of the sheep.	Saponified fat.	94·6	It began to become opaque at 129°, and the thermometer became stationary at 127·5°; it crystallized in small fine radiated needles.
	Soluble matter.	5·4	The syrup of the sweet principle weighed 8, the acetate 0·6; it had a rancid odour.
Stearine of the ox.	Saponified fat.	95·1	It began to become solid at 129°, but it was not perfectly so until 125·5; it crystallized in small needles united into flattened globules.
	Soluble matter.	4·9	The syrup of the sweet principle weighed 9·8, the acetate, 0·3.
Stearine of the hog.	Saponified fat.	94·65	It began to grow solid at 129°, and the thermometer became stationary at 125·5°; it crystallized in small needles united into flattened globules.
	Soluble matter.	5·35	The syrup of the sweet principle weighed 9, the acetate 0·4.

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* This means the salt which we obtain after having neutralized by barytes the product of the distillation of the aqueous fluid which was procured from the soap that had been *decomposed* by tartaric acid.

Stearine of the goose.	Saponified fat	94·4	It became solid at 119°; it crystallized in needles united in the form of a funnel.
	Soluble matter.	5·6	The syrup of the sweet principle weighed 8·2.

All the soaps of stearine were analyzed by the same process as the soap of the fat from which they had been extracted; there was procured from them the pearly super-margarate of potash and the oleate; but the first was much more abundant than the second. The margaric acid of the stearines had precisely the same capacity for saturation as that which was extracted from the soaps formed of fat. The margaric acid of the stearine of the sheep was fusible at 144°, and that of the stearine of the ox at 143·5°, while the margaric acids of the hog and the goose had nearly the same fusibility with the margaric acid of the fat of these animals.

Of the Elaïnes.—They were all fusible at 59°; there was no deposit from them after they had been kept for a month in closed vessels; none of them were acid. *Human elaïne* is yellow, without odour, specific gravity ·913; *elaïne of the sheep* is without colour, has a slight smell of the sheep, specific gravity ·916; *elaïne of the ox,* without colour, almost without odour, specific gravity ·913; *elaïne of the hog,* without colour, almost without odour, specific gravity ·915; *elaïne of the jaguar,* of a lemon colour, odorous, specific gravity ·914; *elaïne of the goose,* of a light lemon colour, almost without odour, specific gravity ·92·9.

Solubility of the different Elaïnes in Alcohol of ·7952.

Human elaïne: 11·1 gr. were dissolved by 9 gr. of boiling alcohol; the solution began to become opaque at 170·5°.

Elaïne of the sheep: 3·76 gr. were dissolved at the temperature of 167° by 3·05 gr. of alcohol; the fluid began to become opaque at 145·5°.

Elaïne of the ox: 5·8 gr. were dissolved at the temperature of 167° by 4·7 gr. of alcohol; the fluid began to become opaque at 145·5°.

Elaïne of the hog: 11·1 gr. were dissolved at the temperature of 167° by 9 gr. of alcohol; the fluid began to become opaque at 143·5°.

Elaïne of the jaguar: 3·35 gr. were dissolved at the temperature of 167° by 2·71 gr. of alcohol; the fluid began to become opaque at 140°.

Elaïne of the goose: 11·1 gr. were dissolved at the temperature of 167° by 9 gr. of alcohol, the solution did not become turbid until 123·5.

by Potash.—The determination of the soluble elaïnes yield to water in the process of saponification is much more difficult than the determination of the same point with respect to the stearines. The stearines are less subject to be changed than the elaïnes; it is less difficult to obtain the stearines in a uniformly pure state; besides the saponified fats of the stearines being less fusible than the saponified elaïnes, it is more easy to weigh them without loss. The elaïnes of the sheep, the hog, the jaguar, and the goose, extracted by alcohol, yield by the action of potash,

Of saponified fat..........	89 parts
Of soluble matter.........	11

The elaïne of the ox extracted in the same manner yields

Of saponified fat..........	92·6 parts
Of soluble matter.........	7·4

The memoir terminates with the following general conclusions. The different kinds of fat, considered in their natural state, are distinguished from each other by their colour, odour, and fluidity.

The cause of their colour is evidently a principle extraneous to them, since they may be obtained colourless. It is the same with respect to their odour; for if we do not always deprive them entirely of it, we can remove a portion of it, which is sufficient to prove that it must not be confounded with the fixed fatty bodies from which it has been separated. The reduction of the different kinds of fat into stearine and elaïne explains the different degrees of fluidity which they possess; but it may be asked, whether we ought to regard stearine and elaïne as composing two genera, which embrace various species, or as two species, each of which may be absolutely represented by a stearine or an elaïne obtained from any one of the fats which have been described above.

If the stearines and elaïnes are identical, they ought to exhibit exactly the same phenomena, when they are placed in the same circumstances, under all possible relations. They should have the same external appearance, the same solubility in alcohol, the same decomposition by potash, and consequently the margaric and the oleic acids, and the sweet principle which they yield, should be identical, and in the same proportion. Viewing the subject in this manner, we may easily answer the question, for we have only to examine whether the stearines and the elaïnes actually present this identity of properties. Now we have observed differences between the stearines when they have been brought to the same degree of fusibility. Those of the human subject, of the sheep, the ox, and the goose, coagulate into a mass, the surface of which is flat; that of the hog into a mass, the surface of which is unequal. The stearines of the sheep, the ox, and the hog, have the same degree of solubility in alcohol; the stearine of man is a little more soluble, while that of the goose is twice as much so. The elaïnes of man, of the sheep, the ox, the jaguar, and the hog, have a specific gravity of about ·915; that of the goose of about ·929. The elaïnes of the sheep, the ox, and the hog, have the same solubility in alcohol; the elaïne of the goose is a little more soluble. On the other hand, the margaric acids of man, of the hog, of the jaguar, and of the goose, cannot be distinguished from each other; those of the sheep and the ox differ a few degrees in their melting point, and a little also in their form. As for the slight differences which the oleic acids present, they are not sufficiently precise for us to be able to particularize them.

M. Chevreul's Seventh Memoir.[*]

This memoir consists of three parts; the first of which is on spermaceti, or as M. Chevreul technically calls it, cetine. In the fifth memoir, in which we have an account of many of the properties of this substance, it was stated that it is not easily saponified by potash, but that it is converted by this re-agent into a substance which is soluble in water, but has not the saccharine flavour of the sweet principle of oils; into an acid analogous to the margaric, to which the name of cetic was applied; and into another acid, which was conceived to be analogous to the oleic. Since he wrote the fifth memoir, the author has made the following observations on this subject: 1. That the portion of the soap of cetine which is insoluble in water, or the cetate of potash, is in part gelatinous, and in part pearly; 2. That two kinds of crystals were produced from the cetate of potash which had been dissolved in alcohol; 3. That the cetate of potash exposed, under a bell glass, to the heat of a stove, produced a sublimate of a fatty matter which was not acid. From this circumstance M. Chevreul was led to suspect that the supposed cetic acid might be a combination or a mixture of margaric acid and of a fatty body which was not acid; he accordingly treated a small quantity of it with barytic water, and boiled the soap which was formed in alcohol; the greatest part of it was not dissolved, and the alcoholic solution, when cooled, filtered, and distilled, produced a residuum of fatty matter which was not acid. The suspicion being thus confirmed, M. Chevreul determined to subject cetine to a new train of experiments, which are now to be related. Being treated with boiling alcohol, in the same manner with hog's-lard, as mentioned in the third memoir, a cetine was procured which was fusible at 120°, and a yellow fatty matter which began to become solid at 89·5°, and which at 73·5° contained a fluid oil, which was separated by filtration.

Cetine in this state, fusible at 120°, was more sonorous, more brilliant, and less unctuous than the spermaceti of the shops; it had less smell, and was somewhat less soluble in alcohol; for 100 parts of alcohol of the specific gravity of ·821 dissolved only 2·5 parts of it, while it dissolved 3·5 of the common spermaceti. The solution was neither acid nor alkaline; by cooling, it produced an abundant deposit of small pearly plates. The action of potash upon the purified cetine was then examined. As the saponification of cetine is a tedious operation, and the potash is apt to act upon glass vessels, a digester was employed, and 20 parts of cetine were added to the same quantity of potash, dissolved in 100 parts of water. The process was repeated 10 times upon the same materials, when the matter which remained in the retort appeared to be completely saponified; this was added to the fluid that was distilled over, and the whole was mixed with a solution of tartaric acid. A watery fluid and a fatty matter were thus obtained, the latter of which amounted to 18·45 parts.

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[*] Abstracted from Ann. de Chim. et Phys. vii. 155. (Feb. 1818.)

The aqueous fluid was distilled, the product had only a very slight odour; when neutralized by barytes it afforded a minute quantity of yellowish acetate, and by evaporation a portion of a yellow, syrupy fluid was procured. The fatty matter from the soap of cetine was of a lemon colour; after being melted at the surface of water, its fracture exhibited a lamellated and shining texture. It was subjected to a temperature of 131°; and when the thermometer fell to 112° it began to grow solid, but it continued to fall to 102°, at which point the congelation was complete: when melted with water it congealed at about 111°: 100 parts of alcohol of the specific gravity of ·817 dissolved 115 parts of the fatty matter; the solution remained transparent for a considerable time; but after standing for 24 hours, it deposited some very fine, brilliant needles; it strongly reddened litmus, and the red colour was converted into a blue by the addition of water.

A train of experiments was then entered upon to discover whether the whole of the substance was in the acid or saponified state; the results of which indicated that the fatty matter contained two substances, one which was acid, and another which was not so; in order to ascertain the proportions in which they existed, the substance was treated first with barytes, and afterwards with successive portions of alcohol; and by separating the portion which was soluble in this medium from that which was not so, it was found to consist of

Acid fat................	63·79
Fat, not acid............	36·21
	100·00

These two bodies were then examined separately. The acid fat, after being melted, crystallized in small, radiated, yellowish needles. It was completely soluble in the water of potash when boiling, and much diluted; as the solution cooled, it deposited the pearly matter very copiously. By analyzing it in the same way with the other kinds of soaps, the same results were obtained; it was reduced into pearly matter and into a soap which was very soluble in cold water; these were found to be the supermargarate of potash and a soap composed of the oleic acid. When a portion of the oleate of potash was decomposed by tartaric acid, an oleic acid was obtained, fusible at 64·5°, of a yellow colour, soluble in all proportions in alcohol of the specific gravity of ·821, at the temperature of 77°. The following is the composition of the oleates of barytes, strontian, and lead respectively.

Oleic acid	100·00
Barytes..................	31·24
Strontian................	23·18
Oxide of lead...........	100·00

The fat which was not acid, after being kept for some days in a closed vessel, impregnated the confined air with an aromatic odour. It was colourless, and semi-transparent like wax; when it was suddenly cooled on water, the upper surface was flat, and did not present any appearance of crystallization; while the lower surface, which lay upon the water, was deeply furrowed. When it was broken, it appeared to be composed of brilliant plates. A quantity that had been melted in a porcelain capsule was slowly cooled, and the upper surface was then crystallized in small needles which were united into stars. This substance melted at 176°, began to be opaque at 134·5°, and was completely solid at 123·8°; it was perfectly transparent as long as it remained fluid. It appeared to be soluble in alcohol in all proportions; the solution did not affect the colour of litmus. It contained a small quantity of barytes in the proportion of ·066 to 100. By digesting the fatty matter in successive portions of alcohol, and examining the substance that was dissolved, it appeared that this re-agent does not possess the power of decomposing the fatty matter.

This fatty matter was then added to an equal weight of potash, dissolved in a large quantity of water, and subjected in the digester to eight successive operations, when a *flexible saponaceous substance* was procured, of a light yellow colour, fusible at about 144°, and an alkaline liquor which did not contain any of the sweet principle. This *flexible saponaceous substance* was decomposed, and was found to consist of the peculiar fatty matter, which was not acid, described above, and potash, in the proportion of 100 of the former to seven of the potash. When one part of the substance had 40 parts of water added, it lost its semi-transparency and its lemon colour by absorbing the water, and the mixture became milky. After being macerated for three hours, it was boiled, and a perfect emulsion was produced;–

which, when concentrated to half its volume, was covered with little drops, of a yellow oily appearance; these by cooling became solid, absorbed water, and formed a thick, white, mucilaginous fluid. This was diluted with a large quantity of water, and had all the soluble part of it removed by repeated ablutions. The insoluble matter resembled a gelatinous hydrate of alumine; when heated gently in a small capsule of platinum, it was converted into a milky fluid, which was quickly covered with yellow oily drops; as the matter cooled, it resumed the form of an opaque mucilage; and by dissipating all the water, a substance was obtained, which, when melted, resembled a yellow oil. This was found to consist of a fatty matter, which, by the test of litmus, appeared to be very slightly acid, and a minute quantity of potash, in the proportion of 100 to 0·63. From this result, M. Chevreul concludes, that the water had removed from the flexible saponaceous matter a great part of its alkali, and an atom of saponified fat; and that the substance left after the washing, although it contained very little potash, was capable of forming a mucilage with water.

We now proceed to a more particular examination of the fatty substance of the flexible saponaceous matter. This substance, after remaining for some days in contact with water, did not become mucilaginous; it only absorbed a little of the water, and became white. After adding some drops of potash, and exposing it to a gentle heat, a mucilage was immediately formed which was clotted, and not homogeneous, like that described above. This want of homogeneity depended upon an excess of potash, which, not having formed a union with the fatty matter, had exercised such an affinity that it could no longer form a mucilage. This is similar to the action of an alkaline water, which has not the power of dissolving soap. What proves this to be the correct method of viewing the subject is, that if the clotted mucilage be thrown upon a filter and sufficiently lixiviated, a residuum is procured, which, when diluted with water, forms a homogeneous mucilage; the water which passed through the filter held a little soap in solution. This experiment decidedly proves that potash is the cause of the mucilage which the fatty substance forms; but it still remains to be determined whether this substance is united to the alkalies by means of an acid fat, or of the oleic or margaric acid united to a fat which is not acid, or if it possesses this property without any addition.

In order to resolve this question, a portion of the fatty substance was boiled for the space of an hour with hydrate of barytes; the solid matter that was formed was dried, and added to 15 times its weight of alcohol of the specific gravity of ·791, at the temperature of 53·5°; the fluid was filtered, and there remained upon the paper some white flakes, which, after having been treated with muriatic acid and washed with warm alcohol, yielded barytes and an acid fat, fusible at about 68°, which, formed with a weak solution of potash a perfectly limpid solution, and was reduced into the pearly matter and an oleate of potash. The alcohol, which was separated from the flakes, and which had dissolved the greatest part of the matter subjected to its action, was evaporated; the residuum, still containing barytes, was treated with cold alcohol, the solution, when separated by filtration from some flakes of the soap of barytes which were not dissolved, yielded a fatty matter which was free from barytes.

This matter was fusible at 125·5°; by cooling it crystallized in small radiated needles; it was white, but when fluid, of a light lemon colour. By being heated in a platinum capsule on the sand-bath, it melted, and the greatest part of it was evaporated; by increasing the heat, it inflamed, and a little carbon was left, which burned, leaving a residuum too minute to be appreciated by the balance. Alcohol of the specific gravity of ·812 dissolved it in all proportions at the temperature of 129°. The solution had no action on litmus or hematine; when cooled, it deposited crystals which were not as brilliant as those of cetine. Cetine is also much less soluble in alcohol; for five parts of alcohol of the specific gravity of ·791, which, when heated, dissolved 0·792 parts of cetine, deposited a great part of it at the end of 24 hours, while the solution of this other substance did not become turbid.

Two equal portions of the fatty substance were taken; one was put into pure water, the other into water slightly alkaline; they were digested during two hours, twice evaporated to dryness, and the residue had each time water added to it. No mucilage was obtained by this process, and none was obtained when the alkaline part of the second portion was replaced by pure water, and when, by being melted several times in water, it was obtained free from potash. The fatty matter kept in pure water became white on its surface; but after being exposed for a moment to the sun, it became yellow and semi-transparent; in this state it melted without disengaging any water. Hence it follows that the fatty matter fusible at 125·5°, which is obtained from cetine by treating it with potash, is not acid, when it has been purified by barytes and alcohol from a small quantity of the margaric and oleic acids, and that it is not susceptible of forming a mucilage with potash.

Having now observed the action of potash and of the saponified part of the cetine upon the part which is not saponified, our next object will be to examine the action of the water of potash, and of the margaric acid upon cetine. Eleven parts of margaric acid which was fusible at 129°, and seven parts of cetine fusible at 118·5° were employed, this being nearly the proportion in which the saponified and the unsaponified cetine exist in the cetine which has been subjected to the action of potash: 16 parts of water and 18 of potash were added. The mixture was heated, and a gelatinous magma was formed; to this a quantity of water was added; it was boiled for some time, digested during two days, and again heated, when the following phenomena were observed during the cooling.

At 212° the fluid was milky, without, however, exhibiting any appearance of flakes; at 150·5° it began to become transparent, and flakes were visible in it: and at 140° its transparency was much increased. It preserved its transparency to 132·5°, but below this it gradually lost it, so that at 122° objects could not be seen through it, and white flakes began to be formed in the parts which cooled the most rapidly; at 114·5° the fluid was so viscid that it resembled a pearly jelly; and at 113° it was perfectly opaque. As it cooled still further it entirely lost its viscidity; and it is remarkable, that after being left for some days, it was reduced to a solid mass, swimming in a perfectly transparent fluid, exhibiting an appearance similar to that of blood after it has separated into the coagulum and the serum.

The fluid was decomposed by tartaric acid, and there were obtained an aqueous fluid which, after evaporation, yielded to alcohol a small quantity of a syrupy matter, which was not saccharine, and nearly colourless, and about 18 parts of a fatty matter, fusible at 118·5°. This substance was treated with water of barytes, and the soap that was formed was digested in boiling alcohol, when the following results were obtained. 1. A residuum insoluble in boiling alcohol, which, when decomposed by muriatic acid, produced 13·89 parts of a fat which was completely saponified, fusible at 127°, and perfectly soluble in potash ley. 2. A soap of barytes, which was deposited from the alcohol as it cooled, and which, when decomposed by muriatic acid, produced ·205 of fat completely saponified, which, added to the former quantity, made it 14·095 parts. 3. An alcoholic fluid, which, after it had been separated from the preceding soap, was distilled. The residue of the distillation, on being cooled, contained an abundant precipitate; by applying a gentle heat the greatest part of the precipitate was re-dissolved; there only remained 0·185 parts of the acetate of barytes, in the form of small crystals; but the author thinks it more probable that the acetic acid proceeded from the alcohol that was employed than from the cetine.

The alcoholic fluid itself, when concentrated, yielded with water a fatty matter, which had the following properties. It was semi-transparent, and without colour; it became solid at 120°. By slow cooling it presented the appearance of small needles united in the form of stars on the surface; its solution in alcohol had no effect upon hematine or litmus. It appeared to bear a strong analogy to the portion of the cetine which resisted the action of potash; but its quantity was to the acidified part in the proportion of 52·64 to 47·36, instead of the proportion of 36·21 to 63·79, which was obtained by directly treating cetine with potash. The part which was not acid was, therefore, treated with its weight of potash in the digester, and the operation was repeated eight times: a flexible saponaceous mass was obtained, which produced a fat that was treated with water of barytes. The soap then produced was acted upon by alcohol, and yielded

Acid fat, soluble at 116·5°	0·82 parts
Fat, which was not acid, soluble at 123·5°.	2·62
	3·44

By adding together the different products, we have the proportion of acid matter 59·9, and of matter which is not acid 40·1, a result which proves that when cetine is dissolved by the alkaline margarate of potash, the cetine does not undergo all the change which might be produced in it by pure potash.

M. Chevreul thought it desirable to repeat the preceding train of experiments with a margaric acid which was procured from some other substance besides cetine, because if it was found that the two margaric acids acted in the same manner, it would indicate a new point of resemblance between the substances. He accordingly added together 11 parts of the margaric acid from the ox, which was fusible at 134·5°; seven parts of the spermaceti of the shops, fusible at 111°; and 16 parts of water holding in solution 18 parts of potash; they were digested for some time with 500 parts of water, and after being heated to 158°, a thermometer was plunged into the mixture. The fluid was now perfectly opaque and milky; at 147° it began to grow clear, at 140° it was semi-transparent, and at 138° perfectly transparent; at 131° it was again partially opaque, at 129° the pearly matter began to be visible, at 127·5° it was no longer transparent, at 120° there was a great quantity of the pearly matter suspended in it, and the fluid was considerably viscid: the opacity continued to increase as the temperature was lowered.

The saponaceous mass was then decomposed by muriatic acid; 17·9 parts of a fatty matter were procured, which was fusible at 117°; this was treated with water of barytes, and the following substances were afterwards obtained: 1. 13·19 parts of an *acid fat, fusible at* 126°, which was formed from the part of the soap that was insoluble in alcohol. 2. 0·423 parts of an *acid fat, fusible at* 110°; this proceeded from the soap of barytes which had been dissolved by boiling alcohol, and which was deposited from it by cooling. 3. 4·287 parts of a fat which was *not acid, fusible at* 111°. This last product was treated with potash, and the saponaceous mass which was formed was decomposed by an acid; a fatty matter was thus obtained, which was boiled with water of barytes, and then subjected to the action of alcohol; the results were; 1. 1·192 parts of an *acid fat, fusible at* 71·5°; 2. 3·095 parts of a fat which was *not* *acid, fusible at* 123·5°. It appears then that in this process the acid matter was to the matter which was not acid in the proportion of 55·15 to 44·85.

The changes which take place in the transparency of the fluids which have been described, in a range of not more than 10°, are worthy of being noticed, as it may, perhaps, enable us to explain by the laws of chemical affinity some of the phenomena which are observed to take place in the fluids of living animals, and which have been generally supposed to be independent of chemical and physical powers.

The existence of what was called the cetic acid was deduced from the two following observations; 1. That the saponaceous mass resulting from the action of potash on cetine, diluted in water at 176°, did not permit any of the fatty matter to separate at the surface, so as apparently to prove that the fatty matter had been completely acidified by the action of the alkali. 2. That litmus was not reddened by the alcoholic solution of the insoluble matter which is separated when we treat the saponaceous mass of cetine with water, a circumstance which seemed to prove the absence of the super-margarate of potash in this insoluble matter. The first of these observations has been better explained on a different principle; and it now remains to show why the alcoholic solution of a substance, which certainly contains super-margarate of potash, does not affect the colour of litmus. When the true nature of this substance had been discovered, it was at first supposed, that the fatty substance which was not acid might be alkaline, and that it might neutralize the excess of acid in the super-margarate of potash. This opinion, however, M. Chevreul afterwards abandoned, and was induced to ascribe the effects to the great concentration of the alcohol which he employed. The following experiments were performed in order to show that this was the true explanation of the facts. In five parts of alcohol, of the specific gravity of ·791, 0·02 of the super-margarate of potash was heated; a solution was obtained which did not yield any precipitate when it was cooled to 86°, and which did not redden 0·26 parts of a watery extract of litmus, containing 11 per cent. of solid matter, when added to it drop by drop, and even when heated to the boiling point. If five parts of water be afterwards poured into the solution, no precipitate is produced, but the litmus acquires the red colour. To render the experiment more striking, we may tinge the water blue with litmus, to show that the effect cannot depend upon any acid contained in the water; if we then add 10 parts of water to the red fluid, the super-margarate of potash will be precipitated, and the litmus will resume the blue colour. The fact may be explained upon the principle, that the excess of margaric acid in the super-margarate of potash, when dissolved in alcohol of the specific gravity of ·791, is more strongly attracted by the neutral margarate of potash than it is by the potash of the litmus, which is not the case when the margarate of potash is dissolved in alcohol of a specific gravity above 900.

This discovery induced M. Chevreul to examine what was the influence which water exerts on alcohol of the specific gravity of ·791, holding the super-margarate of potash in solution. It was observed that when the watery extract of litmus is added to a solution of the super-margarate in this kind of alcohol, a blue precipitate is produced, which was not dissolved, even when the alcohol was warm; for when it was filtered at the boiling heat, blue flakes were left upon the filter, and the fluid passed colourless. In order to know the extent of this property of litmus, of being insoluble in concentrated alcohol, 0·02 parts of margaric acid were dissolved in five parts of alcohol of the specific gravity of ·791, to which was added 0·26 parts of the watery extract of litmus, when the fluid immediately became of a reddish purple. It was boiled and filtered, the fluid passed through of a red colour, and there remained flakes of a deep red upon the filter.

As the insolubility of the litmus in alcohol does not prevent the margaric acid which is dissolved in this fluid from taking the potash from litmus, we may conclude that there is some other power, besides its insolubility, which prevents the excess of margaric acid in the super-margarate of potash, when dissolved in alcohol, from neutralizing the potash of litmus: this power is supposed to be the affinity which *absolute alcohol* has for fatty bodies in general. This affinity rapidly decreasing in proportion as more and more water is added to the alcohol; and the affinity of alcohol for potash rather augmenting than diminishing by the presence of the water, it may be supposed that *absolute alcohol*, when it dissolves the super-margarate of potash, will tend to diminish the action of margarate of potash on margaric acid less than diluted alcohol, which has less affinity for the excess of margaric acid. Consequently this action of water upon alcohol, joined to that which it has upon the extract of litmus, determines the excess of margaric acid to leave the neutral margarate to combine with the alkali of the litmus. These considerations on the mode in which litmus acts, lead to the conclusion that its indications are relative only, and that we cannot deduce any positive consequences from them until we have taken into account the circumstances under which the bodies are placed.

The second part of the seventh memoir of M. Chevreul is on the oil of the Delphinus globiceps.*

The first chapter contains an account of the properties of the oil. It was extracted by a sand-bath from the cellular texture in which it was contained. It was of a light lemon colour, its odour is said to resemble that of fish combined with the smell of leather soaked in fat; its specific gravity at the temperature of

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* Ann. de Chim. et Phys. vii. 264. (March, 1818.)

68° was ·9178. It was very soluble in alcohol; 100 parts of this fluid, of the specific gravity of ·812, dissolved 110 parts of the oil at the temperature of 158°; the solution remained transparent to 125·5°; 100 parts of alcohol of the specific gravity of ·795, dissolved 123 parts of the oil at the temperature of 68°. This great solubility distinguishes the oil of the Delphinus globiceps from the different kinds of fat which were examined in the last memoir. Neither the oil itself, nor its solutions in alcohol, have any action on the tincture of litmus. 77·22 gr. (five grammes) of the oil being digested with potash for 20 hours, were converted into a saponaceous mass, the solution of which in water was not perfectly limpid. This soap was decomposed by tartaric acid, when an *aqueous fluid* and a *fatty matter* were obtained. The *aqueous fluid* had a very strong acid odour, which was more powerful when the fluid was evaporated. The fixed residuum was treated with alcohol; and when this was evaporated, it left a red syrupy fluid, having a sweet, but at the same time, a very disagreeable taste, which weighed 9·73 gr.

The *fatty matter* was nearly colourless; it became fluid at 68°; when kept during three days at 62·5°, it deposited a considerable number of crystals. Its odour was much more powerful than that of the natural oil; it had a fishy, and extremely rank, disagreeable flavour. Alcohol dissolved it in all proportions, and this solution strongly reddened the tincture of litmus. It weighed 51·6 gr. Hence it follows that the oil consists of

Fatty matter......................	66·8
Substances soluble in water..........	33·2
	100·0

The small proportion of the fatty matter, the strong odour which it developed during saponification, and which was peculiarly powerful during the evaporation of the aqueous fluid, induced M. Chevreul to suppose that the oil of the Delphinus globiceps was analogous to an oil which he had discovered in butter, and which he proposes to make the subject of a succeeding memoir. The want of transparency in the solution of the soap, as mentioned above, led him also to conjecture that the soap might contain a matter which was not acid, analogous to that of the soap of cetine, and that consequently cetine might exist in the oil. The oil was, therefore, exposed to a temperature from 40° to 50°, and crystals were formed which were separated by the filter: the filtered oil, when exposed to the temperature of 26·5°, produced new crystals which were likewise separated from the uncongealed part of the oil.

We begin by an examination of the crystallized part of the oil of the Delphinus globiceps. After being carefully separated from the fluid part of the oil, it was dissolved in boiling alcohol, from which it was precipitated by cooling in the form of beautiful laminated crystals. They were further purified by a second solution in alcohol and subsequent crystallization, and were then compared with cetine. The two substances were found to crystallize in the same manner, whether they were suffered to cool slowly on the surface of water, after having melted them, or were deposited from alcohol. A thermometer plunged into this crysstalline matter when melted stood at 113·5°, when it began to become turbid; at 111° there was a considerable degree of congelation, but the process was not completed until it reached the temperature of 110°. One hundred parts of boiling alcohol, of the specific gravity of ·834, dissolved 2·9 parts of the crystalline matter of the Delphinus and three of cetine: neither of the solutions had any action upon coloured re-agents.

About 0·9 parts of each of the two bodies were separately boiled in double their weight of potash for 30 hours: the cetine became united with the potash sooner than the other substance; indeed a part of it appeared to be incapable of saponification. Yet when this part was digested in a platinum capsule with a solution of potash for 15 hours, an homogeneous mass was formed, although the fluid part did not become transparent. Both the saponified spermaceti and the saponified substance from the Delphinus were heated in a solution of potash, and in both cases the fluids became transparent. After remaining at rest for the space of a year, the fluids were found to have deposited a considerable quantity of *pearly matter:* when they were heated, the pearly matter of both of them disappeared, but more slowly from the crystalline substance of the Delphinus than from the cetine. The fluids, when concentrated, were mixed with the tartaric acid; from the crystalline matter of the Delphinus, 0·82 of a fatty matter, fusible at 104°, was obtained, and from the cetine, 0·76 of a fatty matter, fusible at 100·5.

The two fatty substances were treated with the water of barytes, and the soaps which were formed were then subjected to the action of alcohol at the temperature of the atmosphere. The results were as follows, from the crystalline matter of the Delphinus: 1. A substance which was not acid, fusible at 116·5°, and weighing 0·151; 2. An acid substance, fusible at 113°, weighing 0·552, and which produced a large quantity of *pearly matter*, when dissolved in potash. There was obtained from the cetine: 1. A substance which was not acid, fusible at 125·5°, and weighing 0·227; 2. An acid substance, fusible at 98·5°, weighing 0·385, and which produced much pearly matter with potash. M. Chevreul observes, that if these experiments do not decidedly prove the perfect identity of the crystallizable substance of the Delphinus and of cetine, they at least prove their strong analogy, since potash only partially acidifies them.

We next proceed to an examination of the oil of the Delphinus, after the separation of the crystalline matter. Its colour was a little deeper than that of the oil in its natural state; its odour was more powerful; it was perfectly fluid at 68°; at this temperature its specific gravity was ·924 instead of ·917, which was the specific gravity of the oil in its natural state.

One hundred parts of alcohol, of the specific gravity of ·820, dissolved 149·4 parts of the oil at the temperature of the atmosphere; at 127·5° the solution began to be turbid; it was slightly acid by the test of litmus, and the colour of the fluid was converted into a blue by the addition of water, as if it had contained an acid fat. In order to determine whether this was actually the case, or whether the acidity depended upon the development of the acid which had been detected in the aqueous fluid that was obtained from the soap of the oil, when it was decomposed by the tartaric acid, as mentioned above, the oil was treated with magnesia, because this base has the property of completely neutralizing acids, and does not acidify fatty bodies in the same manner with potash and soda.

About six parts of oil which were slightly acid were mixed with two parts of caustic magnesia, and about 100 parts of water; when subjected to a gentle heat they formed a kind of emulsion. More water was added, and the heat was increased; the fluid was filtered while it was still warm, and was found to be without acidity. Being evaporated to dryness, a residuum was obtained of a red colour, which had the odour of the acid referred to above, and weighed 0·02. The residuum was composed of this acid united to magnesia, and of the orange-coloured matter. The compound of oil and magnesia was put upon a moistened filter, in order to remove from it any water which it might contain; it was then exposed to a gentle heat, and treated with alcohol of the specific gravity of ·791. The solution was concentrated and mixed with water; an oil was obtained of an orange yellow colour, which at the temperature of 59° concreted into a species of butter; it had lost some of its odour, it had no action upon paper stained with litmus, nor did its alcoholic solution affect the tincture of litmus. About 4·5 gr. of this oil were burned, and left only a trace of residuum, which was too small to be appreciated by a very delicate balance. It follows from this experiment that the acidity of the oil of the Delphinus depends upon the acid mentioned above, and not upon a proper acidification of the oil itself.

Five parts of oil which was not acid were saponified by three parts of potash dissolved in water; the substances were kept heated for 15 hours; the saponaceous mass resulting from the operation was then dissolved in water, but the solution was not perfectly limpid. The soap was decomposed by tartaric acid, and the *aqueous fluid* was separated from the *fatty matter*: these two substances were then separately examined. The aqueous fluid was distilled; when it was concentrated into the state of a syrup, water was added, and the distillation was continued, until all the volatile parts which might yet remain in the residuum were driven off; the fluid, after being duly evaporated, was the treated with alcohol of the specific gravity of ·791; this being evaporated, left 0·562 of a sweetish syrup, containing the sweet principle, a little matter having the smell of leather, and an orange-coloured principle, which existed in the oil before it was saponified; for at the instant that the water of potash came into contact with the oil, its colour was converted into a brownish orange, even before the saponification had commenced. Hence the following conclusion is drawn, that the colouring principle, which is found in the aqueous fluid, is not produced by the action of the alkali, but that it is simply set at liberty, and that it afterwards unites with the potash, which renders the presence of it more obvious, by forming with it a compound of a deeper colour. The greatest part of the colouring principle remained in the aqueous fluid, for the saponified fat had scarcely any colour. The product of the distillation of the aqueous fluid was neutralized by the hydrate of crystallized barytes; being then evaporated to dryness, it left 1·73 of a dry residuum, composed of acid 0·937, and of barytes 0·793. This acid was named the *delphinic acid.*

The *fatty matter* was then examined. At the temperature of 68°, a small portion of the fatty matter was congealed; and at 50°, the greatest part of it, whilst the other part was perfectly fluid: it had a light yellow colour. The warm water with which it had been agitated had removed from it its odour of fish and of leather, and there only remained the rancid smell of the saponified fat. Its specific gravity at 68° was ·892: it was very acid: 100 parts of it boiled with portions of water which contained respectively 13·53 parts of potash and 9·5 of soda, produced solutions which were not perfectly limpid.

The fatty matter weighed 3·3 parts; it was digested with water of barytes in excess; it was evaporated to dryness, and the residuum was treated with cold alcohol of the specific gravity of ·791. By this means there was produced 0·715 of a white fat, fusible at 82·5°, which did not redden the tincture of litmus, and soluble in cold alcohol; and 2·585 parts of an acid fat, which remained in combination with the barytes, and which had not been dissolved by the alcohol. This acid fat began to congeal at 71·5°, and at 59° appeared quite solid.

In order to know more accurately the nature of the products which have been described, 40 parts of the oil of the Delphinus were saponified, and the soap was decomposed by tartaric acid. The *aqueous fluid* was distilled, the product of the distillation containing the delphinic acid was neutralized by water of barytes, and then evaporated to dryness: the properties of the delphinic acid and its combination with barytes will be more minutely described hereafter. The *fatty matter* which was separated from the potash by the tartaric acid formed with the water of potash a solution which was almost transparent, from which a very brilliant pearly matter was precipitated: when this was collected upon a filter, a glairy matter was obtained, which dried into a fat varnish. This precipitated substance, and the fluid which had been separated by the filter, were then examined in succession. 1. *The precipitated substance* was treated with the hydrochloric (muriatic) acid; the fatty matter which it yielded was successively subjected, first to the water of barytes, and afterwards to alcohol; by this process there were obtained *an acid fat* and *a fat which was not acid.*

The acid fat was fusible at about 104°; it was completely dissolved by a weak solution of potash. The solution that was formed contained the margaric and oleic acids; it deposited a pearly matter, the margaric acid of which was fusible at 122°, but which, after having been treated by the water of potash, produced an acid which was fusible at 129°. The super-margarate which it formed with potash, contained, for every 100 parts of acid, 8·89 of base: 100 parts of the same acid neutralized 27 parts of barytes and 21 of strontian.

The fat which was not acid was fusible at 89·5°. It was boiled and digested for 20 hours in the water of potash: there was produced a *yellow flexible matter,* and a mother-water, which did not contain either any fatty matter or sweet principle. The *yellow flexible matter,* after being washed in cold water, was melted; it contained 100 parts of the fatty matter and 4·8 of potash. Being treated with boiling water in a retort, a very small portion was carried into the neck, where it attached itself under the form of a weak jelly, while the greatest part was melted at the surface of the water. The matter which was thus washed contained scarcely any alkali, as was proved by treating it with muriatic acid. The fat was fusible at 86°; when treated first with barytes and afterwards with alcohol, there was obtained a little acid fat, and a white fat which was not acid, fusible at 95°.

2. The fluid separated by the filter from the precipitated matter was then examined. This fluid, which was slightly turbid, was rendered completely transparent by being heated: it was decomposed by tartaric acid. The fatty matter thus procured was treated with the water of barytes and with alcohol; by this process there were obtained *an acid fat* and a *fat which was not acid.*

The acid fat was fusible at 70°, and completely soluble in the water of potash: it was converted into super-margarate of potash and oleate of potash. The oleic acid thus obtained was fluid at 59°, it had only a slight odour; 100 parts of it neutralized 27·8 parts of barytes and 20·5 parts of strontian. *The fat which was not acid* was fusible at 61°; it was boiled and digested during 20 hours with the water of potash; a saponaceous mass was obtained which was not separated from the mother-water. This was deprived of the fatty matter, but it still appeared to contain a little of the sweet principle. The saponaceous mass, heated with water, did not form a transparent solution, but it produced a fluid in which a portion of pearly matter was perceptible, and which was covered with a pellicle. This flui treated by an acid produced a fatty matter which was converted into acid fat, fusible at 59°, and entirely soluble in potash, and into a fat which was not acid, fusible at 80·5°.

From these experiments we learn that the oil of the Delphinus globiceps is converted by the action of potash into, 1. Delphinic acid; 2. The sweet principle; 3. Margaric acid; 4. Oleic acid; 5. A matter which is not acid, fusible at 95°; and 6. into a matter which is not acid, fusible at 80.5°.

We now proceed to a more particular account of the delphinic acid.* We have already had occasion to notice the combination of this acid with barytes, and the proportion in which the elements of this compound exist; the following is the method in which their proportion was ascertained. The delphinate of barytes was dried, and then heated in a capsule of platinum; it exhaled a peculiar aromatic odour, which is compared to that produced by the distilled butirate of barytes: † the residuum was neutralized by sulphuric acid: 0·216 parts of delphinate of barytes yielded 0·150 of sulphate, which represent 0·099 of barytes; hence it consists of

Acid	117	100·00
Barytes	99	84·61
	216	

As 84·61 parts of barytes contain 8·88 parts of oxygen, it follows that 100 parts of delphinic acid neutralize this quantity of oxygen in salifiable bases.

After attempting different methods to separate the delphinic acid from the barytes, the following method was adopted. An aqueous solution of the delphinate of barytes was concentrated, and put into a long tube which was closed at one end, and a quantity of a strong solution of phosphoric acid was poured upon it; the mixture was then left at rest for some hours, and the following products were obtained; 1. An aqueous fluid containing the acid phosphate of barytes, mixed with a little delphinic acid; 2. An oleaginous fluid lighter than the first; this was separated by means of a small syphon, and was the pure delphinic acid.

The delphinic acid resembles a volatile oil; it is of a light lemon colour, or even quite without colour, and has a very powerful aromatic odour, analogous to that of cheese or strong butter, or rather to the butiric acid; when the odour was weak, it resembled that of old oil from the Delphinus. It has a very sharp acid taste, which is succeeded by the ethereal flavour of the rennet apple: it left a white spot upon the part of the tongue to which it was applied. The delphinic acid moistened glass, paper, and stuffs, like essential oils; it left on the bodies to which it was applied an extremely disagreeable odour, which it was very difficult to remove, exactly similar to that of the oil of the Delphinus. At the temperature of 57° it had the density of ·941; its boiling point was not ascertained. It is very soluble in alcohol, and slightly so in water; these solutions produce a deep red colour in the tincture of litmus.

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* Ann. de Chim. et Phys. vii. 361. (April, 1818.)

† *The butiric acid is to form the subject of a future memoir.*

The oleaginous delphinic acid was either an hydrate or an hydrogenated acid; for 0·3 parts of this acid being put into a small tube of glass with three parts of the yellow oxide of lead; and the tube, after being introduced into a receiver, being gradually heated, there was produced 0·04 of a watery fluid which had no action upon litmus paper, and at the same time an ethereal odour was disengaged. If we consider the oleaginous delphinic acid as a hydrate, its composition will be

Acid	260	100·0
Water	40	15·4

which contains 13·6 of oxygen; this may be considered as 1½ the quantity of oxygen which the acid saturates in the bases, since 100 of acid neutralize 8·88 of oxygen and 8·88 × 1·5 = 13·32.

The compound of delphinic acid and lead was then treated with water, filtered, and evaporated; the fluid was turbid, and a quantity of delphinic acid was disengaged, which was perceptible by the smell: 0·190 parts of the acid, when well dried, was put into a small capsule of platinum with diluted nitric acid, no sensible effervescence was produced, but the acid odour was perceptible. It was gently evaporated, the residuum was calcined, and there was obtained 0·135 of a perfectly pure yellow oxide of lead, entirely soluble in weak nitric acid. Hence it follows that the delphinate of lead is formed of

Acid	55	100·0
Oxide	135	241·8

This contains 17·3 of oxygen, which is about double the quantity found in barytes, that is, 8·88 × 2 = 17·76: from this it appears that the salt of lead evaporated to dryness is a subdelphinate.

Delphinic acid was neutralized by the water of strontian, and evaporated to dryness: 0·200 parts of the salt were decomposed by nitric acid; the nitrate of strontian which was produced formed 0·132 of sulphate, a quantity which represents 0·07656 of base. Hence we have,

Acid	12344	100
Strontian	7656	62; this con-

tains 8·89 of oxygen.

The delphinic acid was then neutralized with sub-carbonate of lime, and the product was treated in the same manner with the delphinate of strontian; the result was 0·1170 parts of sulphate of lime representing 0·0486 of base. Hence we have,

Acid	1514	100
Lime	486	32; which

contains 9·0112 of oxygen.

The solutions of the delphinate of strontian and of lime, placed under receivers containing quick-lime, crystallized in long prisms. The crystals of the delphinate of strontian became of an opaque white, in consequence of their efflorescing. The delphinate of barytes did not crystallize under the same circumstances.

After having thus made us acquainted with many of the properties of the delphinic acid, M. Chevreul proceeds to inquire, what relation the oil of the Delphinus bears to the delphinic acid. This is a question which he is not at present able to answer in a satisfactory manner, because it would require the elementary analysis of the oil and its acid, which has not been yet accomplished; but the following points may be considered as established.

When the oil is treated with a base, which, like magnesia, has a strong tendency to neutralize acids, without, however, having the property of determining the transformation of a fatty body into the margaric and oleic acids, scarcely any delphinic acid can be separated from the oil. In order to procure the acid, the oil must be treated with a base which is sufficiently powerful to transform a portion of it into the sweet principle, and into the margaric and oleic acids. Without deciding whether this acid be a *product* or an *educt*, it must be admitted that the oil of the Delphinus contains a quantity of matter which experiences the same change with the fatty bodies that have been described in the earlier memoirs; and besides this, a quantity of matter which produces the delphinic acid.

From this result, it seems that we are acquainted with no substances which more resemble the one in question than the hydrochloric, acetic, and other ethers, which do not act upon vegetable colours, but which, however, yield on analysis a considerable quantity of carbon and hydrogen, besides the elements of the hydrochloric and acetic acids. The volatility of the ethers, compared to the fixedness of the oil, should not be considered as an objection to this analogy, since the volatility of ammonia is not so to the analogy of this substance with the fixed alkalies: it must, however, be observed that the analogy is in the first case an analogy of composition, and in the second an analogy of properties. If we are to expect any aid in the prosecution of the science of natural-history from chemical analysis, the composition of the oil of the Delphinus will be an object deserving our attention, as it appears to be unlike any thing else with which we are acquainted, except the oil of butter.

We now come to the third part of the memoir, which treats of the common fish oil of the shops.

It was of an orange brown colour, its odour a compound of that of fish and leather prepared with oil, its specific gravity was ·927 at the temperature of 68°. It remained fluid during several hours at 32°; but after having been exposed for some days to this temperature, a *fatty concrete matter* was deposited, which was in very small quantity only, and was separated by filtration.

The *oil* that was left, after the separation of the concrete fatty matter, was not acid by the test of litmus paper: 100 parts of alcohol, of the specific gravity of ·795, dissolved 122 parts of the oil at the temperature of 167°; the solution began to be turbid at 145·5°; it was not acid. It was treated with potash, when placed under mercury out of the contact of the air: the sweet principle and an acid fat were produced, but no carbonic acid.

Two hundred parts were saponified by 120 parts of potash dissolved in 400 parts of water: the saponification was easily effected, and the soap, which was of a brown colour, was completely dissolved by cold water. It was decomposed by tartaric acid, and there was obtained, 1. *An aqueous fluid;* and 2. *A saponified oil.* These two substances were each of them examined.

1. The *aqueous fluid* was of a deep brownish yellow colour, and had the smell of leather. It was distilled, and the residuum was evaporated, and then treated with alcohol; the alcohol dissolved a sweet principle which was of a yellow colour, and had a very pleasant flavour. The product of the distillation was acid; it perceptibly held in solution an aromatic principle which had the odour of leather. It was neutralized by the water of barytes, and then distilled: the product was without smell. The residuum weighed 0·3; it was the proper delphinate, from which the delphinic acid might be obtained by means of the phosphoric acid. With respect to quantity, this residuum was very different from that which was obtained from the oil of the Delphinus.

2 The *saponified fish oil* had more tendency to crystallize than the oil in its natural state. It was soluble in all proportions in alcohol of ·821; its solution contained the margaric and oleic acids: 100 parts of this oil, when heated, were completely dissolved by portions of water which contained respectively 13·45 parts of potash and 9·15 of soda.

Twenty parts of the saponified oil were boiled with the water of of barytes; the soap that was formed was treated with alcohol, but scarcely any of the fatty matter which was not acid was procured. The saponified oil was treated with a hot solution of potash, a little more than was sufficient to dissolve it: the soap was diluted with water; and after remaining some time at rest, a *pearly matter* and an *oleate* were formed, which were successively examined.

The successive action of the water of potash much diluted and alcohol on the *pearly matter* proved that it contained a perceptible quantity of oleic acid; after this was separated, the following results were obtained. The substance was very brilliant, and perfectly white; it had only an extremely slight odour; it was not dissolved in warm water, but it was completely soluble in a solution of alkali. By cooling, this solution was converted into potash and the super-margarate of potash, exhibiting all the properties which had been formerly described as belonging to this substance. By analysis, it yielded,

Margaric acid	100·00
Potash	8·77

The margaric acid was almost without odour; it crystallized in small, fine, radiated needles. When melted at the temperature of 158°, it congealed at 131°; but as the bulb of the thermometer was not completely covered in this experiment, and as the acid was very turbid at 132·5°, probably this may be more exactly the proper melting point.

The *oleate of potash*, after it had ceased to yield any more pearly matter, was decomposed; the acid was left at the temperature of the atmosphere, and a crystalline substance was separated. After this separation, the following properties were found in it: it was of a brown orange colour, much deeper than that of the oleic acids of the fat of the hog, the sheep, the ox, &c.; but this colour probably depended upon something distinct from the oil itself, whether proceeding from the decomposition of a portion of the oil, or from some other cause. This oleic acid had a strongly marked fishy smell, which it communicated to its combinations with barytes, strontian, and the oxide of lead. These oleates produced the following results by analysis.

Oleic acid	100·00
Barytes	26·77
Strontian	19·41
Oxide of lead	81·81

We now come to the examination of the *concrete fatty matter*. After being drained on bibulous paper, it was acted upon by boiling alcohol, by which a considerable quantity of elaïne was separated; during this process the concrete matter became coloured. It was then melted; a thermometer plunged into it descended to 70°, and as it became solid, rose again to 80·5°. The action of heat entirely removed from it the odour of leather.

Nine parts of alcohol, of the specific gravity of ·795, dissolved five parts of the concrete fatty matter. The solution yielded by cooling, 1. Small radiated needles of the most beautiful white colour; and, 2. Needles of a yellow colour: there remained a viscid mother-water, of a brown colour; and it seemed as if in *this operation* the colouring principle was increased in its quantity; whether it was really formed during the process, at the expense of the fatty matter, or whether it was detached from some substance which previously concealed its colour, it was peculiarly developed by the action of potash. It was observed that the process of saponification developed the leathery odour which the substance had lost by fusion.

3·6 parts of the coloured fatty matter, having been saponified by an equal weight of potash, produced a soap which was decomposed by tartaric acid. 1. The *aqueous fluid* was distilled, and the residuum was treated with alcohol. The alcohol dissolved about 0·25 of a yellow syrup, the taste of which seemed at first to be bitter and astringent, but afterwards became slightly saccharine. The product of the distillation had a slight smell of leather and a little acidity; being neutralized by barytes, 0·03 of a salt was obtained, which had rather the smell of delphinic acid than of leather.

2. The *saponified fatty matter* contained two substances, which were easily separated from each other: the one which was the most abundant constituted 3·06 parts; it was of an orange yellow colour; the thermometer plunged into it, after it was melted, fell to 79·5°, and rose again to 82·5°. This substance, which was very soluble in the water of potash, appeared to M. Chevreul to be entirely formed of the margaric and oleic acids. The second substance, which constituted only 0·14 parts, was brown, infusible at 212°, completely soluble in boiling alcohol, and left no fixed matter when it was incinerated. From this experiment, 100 parts of the concrete matter contain

Fatty saponified matter	88·9
Matter soluble in water	11·1
	100·0

The properties of the concrete substance which is separated from the common fish oil seem to indicate that this substance belongs rather to stearine than to cetine, or to the crystallized substance which is obtained from the oil of the Delphinus. But it is possible that this substance may not be essential to this fish oil; and besides, it exists in so small a quantity, that its nature could not be very exactly ascertained.

Upon the whole, we may conclude that the fish oil which was examined resembles the oil of the Delphinus in its odour, but that it differs from it, 1. In yielding only a trace of the volatile oil after being saponified; 2. In not furnishing any crystalline substance analogous to cetine; 3. In its being more easily saponified than that substance, and without producing any matter which is not acid; 4. In containing much more of the colouring principle.

Besides the delphinic acid which exists in the oil of the Delphinus and in common fish oil, M. Chevreul thinks that we must admit the existence of another principle, which has a fishy odour, and which he conceives to be identical with an odorous principle which he has discovered in the cartilage of the Squalus peregrinus. This substance is peculiarly developed when it exists in combination with ammonia or an ammoniacal salt, and the salt is mixed with caustic potash. It may be doubted, whether the leathery odour of the saponified oil of the Delphinus and common fish oil, and the colouring principle which exists in so considerable a quantity in these oils when they have been long kept, are proximate principles simply disengaged, or the result of some alteration which the principles that were extracted from these oils have undergone, or depend upon some other principles which have hitherto escaped detection.

ARTICLE VI.

On the Sorbic Acid and its different Combinations. By M. Henri Braconnot.*

THE author had been led to conclude that malic acid, as it is usually obtained, is not pure, and had attempted to obtain it from the malate of zinc, a substance said by Scheele to form very beautiful crystals; but he found that the acid thus procured differed essentially from the malic. He was endeavouring to ascertain the exact nature of these differences, when Mr. Donovan announced his discovery of the sorbic acid. M. Braconnot objects to the method adopted by Mr. Donovan, both as being one by which the acid is obtained in small quantity only, and in an impure state. M. Braconnot recommends the following process: the fruit of the Sorbus Aucuparia is to be taken before it is quite ripe, and is to be bruised in a marble mortar and strongly squeezed. It must then be boiled, and carbonate of lime must be gradually added until all effervescence ceases; it is then to be evaporated to the consistence of a syrup, the froth being carefully removed as it continues to form. The sorbate of lime is quickly precipitated in the form of a granulated salt; the supernatant fluid is to be poured off, the salt washed in cold water, and dried with a linen cloth. The salt has a slight yellow tinge, which indicates that it is not pure; it is, therefore, to be boiled for a quarter of an hour, with an equal weight of crystallized sub-carbonate of soda diluted with water. A neutral sorbate of soda is thus procured, which is soiled by a red colouring matter, to remove which it must be warmed for some minutes with lime water, or cream of lime, which will remove the colouring matter, and leave the sorbate of soda untouched. The liquor must then be filtered, and will be found to be limpid and colourless; pass through it a current of carbonic acid gas to separate the lime which it may contain; the sub-acetate of lead is then to be added, which will form a very white precipitate of the sorbate of lead, from which, after having well washed it, the sorbic acid must be disengaged by diluted sulphuric acid assisted by heat. By this process, M. Braconnot informs us that the sorbic acid may be obtained in a perfectly pure state; it is uncrystallizable, and attracts moisture.*

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* Abridged from Ann. de Chim. et Phys. vi. 239. It is probable that the experiments of M. Braconnot and those of M. Vauquelin are to be regarded as equally original, and that they must have been performed about the same time. M. Braconnot's paper was read to the Royal Society of Sciences at Nancy, in November, 1817; and M. Vauquelin's paper was published in the number of the Ann. de *Chimie et de Physique* for the following month.

With respect to the characters of the sorbates, M. Braconnot observes, that the tartrates are the vegetable salts which bear the strongest analogy to them; from their property of combining with an excess of acid which, in most cases, diminishes their solubility. But as the two acids differ in their power of crystallizing, we may lay it down as a general principle, that when the tartaric acid forms a salt that is only slightly soluble with any base, the sorbic acid will form a crystallizable salt with the same base; and whenever a tartrate shall be uncrystallizable, by a still stronger reason the sorbate of the same base will be so likewise.

In the formation of the sorbates, 100 parts of sorbic acid saturate a quantity of base which contains about 11 parts of oxygen. Tartaric acid has a greater capacity for saturation; according to Berzelius it is 11·94, while he estimates that of citric acid at 13·588, that of acetic acid at 15·43, and that of oxalic acid at 22·062. The sub-sorbates contain a quantity of acid, double of that which is contained in the neutral sorbates. All the sorbates swell up by heat, and generally are disposed to attach themselves to the vessels in which they crystallize. The sorbates of potash, soda, and ammonia, are uncrystallizable and very soluble. M. Braconnot formed a neutral sorbate of lime, by pouring muriate of lime into the solution of sorbate of soda; it was in the form of transparent, granulated crystals, which are not affected by the air, and contain no water of crystallization. It requires for its solution 147 parts of water, at the temperature of 53·5° Fahr.; and less than 65 parts of boiling water. It is composed of

Sorbic acid	72	100·00
Lime	28	38·89
	100†	

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* We have it not in our power to decide upon the respective merits of the processes of Mr. Donovan and M. Braconnot; but we may observe that Mr. Donovan's succeeded in the hands of M. Vauquelin.—Ed.

† This differs a little from Vauquelin's estimate.—Ed.

M. Braconnot also formed an acidulous sorbate of lime, by dissolving the neutral sorbate in sorbic acid. This salt presents prismatic crystals with six faces; it is very acid, and requires for its solution no more than 50 parts of water at the temperature of 53·5°. It is composed of

Sorbic acid	65·48	84·63	100·000
Lime	11·99	15·47	19·483
Water	22·53		
	100·00	100·00	

M. Braconnot has procured three sorbates of zinc, a neutral sorbate, a super-sorbate, and a sub-sorbate. The neutral sorbate is formed directly by combining the sorbic acid with the oxide of zinc, or in decomposing the sorbate of lime by sulphate of zinc. It is composed of

Sorbic acid	58·05	64·5	100·000
Oxide of zinc	31·95	35·5	55·426
Water	10·00		
	100·00	100·0	

The super-sorbate is prepared by dissolving neutral sorbate of zinc in sorbic acid, and washing the crystals in alcohol or in water. It contains

Sorbic acid	71·88	78·41
Oxide of zinc	19·79	21·59
Water	8·33	
	100·00	100·00

The sub-sorbate of zinc separates naturally from the watery solution of the neutral sorbate; it is insoluble in boiling water, and consists of

Acid	51·89
Oxide of zinc	48·11
	100·00

M. Braconnot has examined the sorbate of lead; he finds that there is no super-sorbate, and that its solution in water does not redden litmus. By examining the crystallized sorbate of lead, well dried, and afterwards calcined in a platinum crucible, he estimated that it was composed of

Sorbic acid	38·85	100·0
Oxide of lead	61·15	157·4
	100·00	

If the sorbate of lead be obtained by double affinity, it affords different results; in this case it consists of

Sorbic acid	32·57
Oxide of lead	67·43
	100·00*

M. Braconnot is, however, inclined to suppose that the salt obtained by double decomposition is a mixture of the neutral sorbate and the sub-sorbate, because the oxygen in the oxide of lead which saturates 100 parts of sorbic acid is 11·253 according to the first analysis, and 14·7 according to the second. Sub-sorbate of lead may be procured by digesting ammonia upon the neutral sorbate of lead; the sub-sorbate does not form a hard or granular mass with boiling water, as is the case with the neutral sorbate. M. Braconnot has also formed the sorbates of strontian, barytes, magnesia, alumine, and the protoxide and deutoxide of mercury, of silver, copper, iron, manganese, and tin; these salts are very soluble, uncrystallizable, and deliquescent.

Experiments on the Sorbic Acid. By M. Vauquelin.†

In the year 1816 Mr. Donovan discovered in the fruit of the Sorbus Aucuparia a new acid, possessed of specific properties; and also announced that this acid exists in other vegetables. M. Vauquelin has repeated the experiments of Mr. Donovan; he has confirmed the discovery of the new acid, and has made a number of observations upon it, which had not been noticed by the discoverer.

The author began by obtaining a very large quantity of the juice of the ripe Sorbus, no less than 50 quarts.‡ The juice, when recently procured, is viscid, so as to pass with difficulty through a filter; but by remaining for about a fortnight in a warm temperature, it experiences the vinous fermentation. It then becomes bright and clear, easily passes through the filter, while a quantity of yeast is separated from it. By distillation, a portion of alcohol, of a specific odour and flavour, may be procured from the fermented juice, whence it is inferred that the recent juice must have contained saccharine matter. The sorbic acid itself does not appear to be affected by this fermentation. No malic acid could be detected in the recent juice of the sorb. The viscidity of the recent juice did not appear to depend, in any degree, upon jelly mixed with it, but upon a substance more analogous to vegetable gum. The juice of the sorbus, after fermentation, still contains a red colouring matter, which passes to a violet purple by the contact of tin, and which becomes a greenish yellow by the action of alkalies. The juice also contains a very acrid and hot principle, which has some analogy with that which we meet with in Pyrethrum; it is soluble both in water and in alcohol, and is always accompanied by a brown and bitter substance. The berries of the sorb, after being bruised and expressed, retain a yellow matter, which may be separated by warm alcohol, or ether, and which seems to have some resemblance to a resin; it is principally attached to the parenchymatous part of the fruit.

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* The estimate agrees very nearly with Vauquelin's, who also formed his sorbate of lead by precipitation.—Ed.

† Abridged from Ann. de Chim. et Phys. tom. vi. p. 337. (Dec. 1817.)

‡ The readers will observe that M. Vauquelin differs from M. Braconnot in employing the fruit in its ripe state; it remains to be determined whether this circumstance was the difference which was observed between the substance as procured by these chemists.—Ed.

The recent juice of the sorb is of a red colour, and of a very acid flavour, mixed with a degree of bitterness. When the carbonate of lime is added to it, an effervescence is excited; but whatever quantity we employ, the fluid always continues acid. If this solution of the super-sorbate of lime be poured off, and the carbonate of potash added, a brisk effervescence takes place, and a white powder is precipitated, which consists of neutral sorbate of lime: 100 parts of the precipitated sorbate of lime, when well dried, were decomposed by heat, and appeared to consist of

Acid........................	67
Lime	33
	100

When acetate of lead is poured into the juice of the sorb, a precipitate is formed, which is white, thick, and bulky. By standing a few hours, however, its bulk is much diminished, and it assumes a brilliant, crystalline appearance, which begins at the surface, and is gradually continued to the bottom of the vessel; the supernatant fluid also deposits crystals, which are more white, more bulky, and more brilliant. If the precipitate be collected in separate portions, the first is highly coloured; the second, less so; and the last, nearly without colour.

When the juice of the sorb is saturated by potash instead of lime, and afterwards precipitated by acetate of lead, the precipitate, instead of being rose-coloured, is greenish yellow; in this case it is much longer in acquiring the crystalline appearance. Five grammes (77·22 grs.) of subcarbonate of potash will saturate a decilitre (6·1 cubic inches) of the juice of the sorb.

The sorbate of lead is nearly insoluble in cold water; but a little more so in boiling water: as it cools, it crystallizes in beautiful needles, white, brilliant, and shining, which have a considerable resemblance to sublimed, benzoic acid. A remarkable phenomenon occurs when sorbate of lead is boiled in water. Whilst one part of the salt saturates the water, the other part, for want of a sufficient quantity of fluid to dissolve it, is partially melted, is at first kept on the surface by the force of ebullition, but after some time falls to the bottom, and as it cools becomes strongly fixed to the vessel. As the solution of the sorbate of lead is slightly acid, Mr. Donovan supposed that there was both a super-sorbate and a sub-sorbate; but in this he was mistaken; for by treating the supposed sub-sorbate with a fresh quantity of water, it is all dissolved, and reduced to the same state. The sorbate of lead contains 12·5 per cent of water; when it is dried, it is composed per cent. of

Sorbic acid	33
Oxide of lead	67
	100

M. Vauquelin used every means to detect malic acid in the juice of the sorb, but without effect; he was, therefore, led to suppose that what Mr. Donovan had taken for the malate of lead was a mixture of phosphate of lead and a colouring matter, united to the oxide of lead.

The method which Mr. Donovan has pointed out for procuring the sorbic acid appears a very correct one. It consists in partially decomposing the sorbate of lead by sulphuric acid, and in passing through the fluid a current of sulphuretted hydrogen. The fluid is then filtered and concentrated. M. Vauquelin observes, that in order to obtain this acid colourless and very pure, it is necessary to employ sorbate of lead that has undergone several successive crystallizations, as it contains a colouring matter and a portion of phosphoric acid.

When the sorbic acid is evaporated to the consistence of a syrup, it forms mammilated masses of a crystalline structure; it still contains a considerable quantity of water, and deliquesces when exposed to a moist atmosphere. Lime water and barytic water are not precipitated by the sorbic acid when in solution, although the sorbate of lime is only slightly soluble. One of the most characteristic properties of the sorbic acid is the precipitate which it gives with the acetate of lead, which is at first white and flocculent, but afterwards assumes a crystalline appearance. Potash forms a deliquescent salt with the sorbic acid; barytes forms with it a salt which is more crystallizable, but the form of which it is not easy to ascertain. The salt deprived of water consists of

Sorbic acid	47
Barytes	53
	100

The sorbic acid is with difficulty saturated by the oxide of copper even when warm; the sorbate of copper does not crystallize; dried in a capsule it leaves a varnish of a beautiful green colour. By means of nitric acid the sorbic is converted into the oxalic acid; nitrous gas and carbonic acid are disengaged. From this, as well as from its properties generally, M. Vauquelin concludes that the sorbic acid is the one which approaches the most nearly to the malic.

For the purpose of analyzing the sorbic acid, the deutoxide of copper, and the sorbate of lead, both well dried, were heated together in the apparatus contrived by Prof. Berzelius. One gramme (15·444 grs.) of the sorbate of lead were mixed with five times its weight of the oxide of copper; and two grammes (30·888 grs.) more of the oxide were used to cover the mixture. One hundred and seventy cubic centimetres of gas were procured, which being totally absorbed by potash must have been carbonic acid. The loss of weight in the apparatus was 800 milligrammes. The quantity of acid contained in the sorbate of lead must have been, according to this analysis, 330 milligrammes. From these data we learn, that the sorbic acid is composed of

Hydrogen	16·8
Carbon	28·3
Oxygen	54·9
	100·0

With respect to the relation which the constituents of the acid bear to each other, they appear to be nearly as the numbers one, two, and three. The relation which exists between the quantity of oxygen in the acid and that of the bases which it saturates is as four to one. As the pure sorbic acid appears to be without odour and without colour, and of an agreeable flavour, the author suggests that it might be substituted for the tartaric and citric acids in medicine and the arts.

ARTICLE VII.

On the colouring Constituent of Roses, and of the Flowers and Leaves of other vegetable Bodies. In a Letter to the Editors. By Edward Daniel Clarke, LL.D. Professor of Mineralogy in the University of Cambridge, &c.

(*Continued from* No. II. Vol. xii. p. 128.)

GENTLEMEN,

In the conclusion of the thirteenth article of your number for *August,* I promised to continue my observations upon the colouring constituent of vegetables, and to ascertain, if possible, whether this principle ought in every instance to be ascribed to *iron.* The presence of *iron* in those bodies will, perhaps, appear to be evident when I have communicated the result of a few subsequent experiments; and if it be considered how very inconsiderable a portion of this metal communicates a blue colour to the *sapphire* and a red colour to the *ruby*, it is hardly possible to conceive that any notable portion of it can exist in the flowers and leaves of plants without being manifested by some of the various hues by which the metal is characterized in its different combinations, when acted upon by light, heat, and atmospheric air.

Before I proceed to detail any of these experiments, it is proper to notice some very powerful objections which have occurred respecting the presence of *iron* in the precipitate which I obtained from the *infusion of roses*, by means of *ammonia*, as mentioned in my last; of which I transmitted a portion to you, and to other eminent chemists, soon after the publication of my former letter. This precipitate was found to burn to a *white ash*, in which no portion of *iron* could be detected sufficiently considerable to entitle it to the distinction of a *colouring agent;* and hence it was inferred, as a probable conjecture, that the *metallic iron*, which I sent also to you, was due to the *prussiated alkali* used in the experiment. In answer to which, it may be urged that we must cease to employ this re-agent as a test of the presence of *iron*, if the mere touch of a glass rod, dipped in a solution of *prussiate of potass*, be capable of communicating such a considerable portion of the metal, to fluids before destitute of it, as to account for the *metallic* and *magnetic* beads exhibited to you, and which were obtained from such inconsiderable volumes of a solution as test-tubes are fitted to contain. But I trust I shall be able to show, that the *iron* is really due to the vegetable infusion to which it was ascribed; having, by means of other tests and other experiments, not liable to these objections, obtained the same results; not only from the petals of *roses*, but from the leaves of plants, and from flowers of all colours. It must remain, therefore, for your chemical readers to determine, whether *iron*, existing under such various modifications, and differing only as to its quantity, however decisively its presence may be demonstrated, ought to be considered as having any connexion with the colour of the vegetable in which it resides.

(A.)—The *colouring principle* in vegetable extracts, whatever be its nature, being soluble in water, as admitted by *Chaptal*,[*] and also by *Thenard*,[†] with whose observation I terminated the last communication I made to you upon the subject, I resolved to try an experiment with the petals of the damask rose, using no other solvent than water. For this purpose, I made an infusion, by boiling distilled water in a Florence flask, and pouring it, in a boiling state, upon a quarter of a pound of the dried petals, which I left in a porcelain vessel for several hours. Afterwards collecting the clear infusion which had assumed a deep red colour, I submitted it once more in a Florence flask to the heat of an Argand lamp, and evaporated the whole to dryness. There remained, at the bottom of the flask, a *black carbonaceous substance* which had the smell of burned sugar. A portion of this substance being placed within a cavity scooped in a stick of charcoal, was exposed to the action of the common blow-pipe; and, as it fused very readily, it was soon reduced to a very small black bead; which, resisting the utmost action of the blow-pipe, was held for a considerable time in a state of fusion, attended with phosphorescence and ebullition. After being cooled, its form was perfectly globular, and it was attracted and taken up by a *magnet*. It was then hard enough to be driven into the end of a deal splinter, and filed. Particles with *metallic* lustre were by this means rendered conspicuous. I have sent one of these beads to you for examination, corresponding in appearance with the *iron* I before transmitted to you, and having the same *magnetic* character. But in other trials, made with the same *carbonaceous substance*, sometimes I obtained the black *magnetic* beads, and at other times, owing to causes I am unable to explain, it burned to a *white ash*, containing no *magnetic* particles. The same substance being exposed to the action of the *gas* blow-pipe, exhibited combustion with minute sparks, and was speedily converted into a white opaque glass; probably owing to a portion of *lime* which has been detected in the precipitate thrown down by *ammonia* from the *infusion of roses*, as described in my last letter; and which acting as a solvent for the colouring matter,* may, perhaps, explain the presence of a metallic oxide in the vegetable.

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[*] "Nothing more is necessary than to infuse these substances in water, for the purpose of extracting their colouring principle."—*Chaptal's Chemistry*, vol. iii. p. 151. London, 1795.

[†] Traité de Chimie, tome troisieme (1716), p. 376. Paris, 1815.

(B.)—The *magnetic* beads, mentioned in A, being dissolved in acids, and the acid, in every instance, evaporated to dryness, and distilled water added, and afterwards filtered, *tincture of galls* threw down a dark precipitate; and *prussiated alkali*, a deep emerald green precipitate; the latter, collected on a filter, became afterwards blue.

(C.)—The precipitates mentioned in B exposed to the action of the *common blow-pipe* upon *charcoal*, were again converted into beads acting upon the *magnet;* and after admitting the action of the file again, disclosing a *metallic* lustre. Exposed to the *gas blow-pipe*, combustion with scintillation ensued, as in the combustion of particles of *iron*.

(D.)—The presence of *iron* appearing to have been thus satisfactorily ascertained in the *carbonaceous substance* obtained by the evaporation to dryness of an *infusion of roses*, as related in A, some of this substance was triturated in a porcelain mortar, and being reduced to a fine powder, was boiled in diluted

* See Chaptal, vol. iii. p. 154.

muriatic acid. The acid being then filtered, was evaporated, with gentle heat, to dryness; and distilled water afterwards added and filtered. The surface of the clear filtered liquor was now touched with a glass rod, dipped in *tincture of galls;* a pale whitish precipitate appeared which, upon warming the liquor, became chocolate brown, and afterwards black. Some of the same liquor, in a separate vessel, touched with a glass rod dipped in a very diluted solution of crystallized *prussiate of potass,* instantly exhibited an abundant blue precipitate.

From the foregoing observations, it is plain that the petals of *red roses* contain *iron;* and, perhaps, the medical virtues ascribed to the *infusion of roses,* if they exist at all, may be due to the very inconsiderable portion of the metal present in the infusion. We all know how very insignificant are the chemical constituents of many chalybeate waters, destitute of which their salutary properties no longer characterize them; and also that when art attempts to supply what Nature has thus sparingly afforded, the same deficiency ensues.

Afterwards I submitted other vegetable bodies to a similar investigation, and found evident traces of *iron,* although not always in equal quantity, in the petals of *blue, yellow,* and *white* flowers, and in the *green* leaves of several plants, especially in the petals and leaves of *centaurea cyanus, verbascum thapsus, phlox paniculata alba, alcea ficifolia,* &c. &c. *White* flowers contain the smallest portion of the metal; and its exhibition is more difficult during their examination than in other instances. Infusions made of the *green* leaves of the *fig-tree* are sometimes used, when highly concentrated, to remove grease spots from black cloths and stuffs. I examined an infusion of this kind made with distilled water, two quarts of it being reduced by boiling, in glass vessels, to a pint. From this infusion, a single drop of *tincture of galls* immediately threw down a *whitish* precipitate, which separated and became darker by being heated; and when collected on a filter was found to contain IRON. *Ammonia* caused a more copious precipitate of the same nature, but of a mud colour; and this also contained *iron.* The same results were obtained in the examination of an infusion, similarly made, of *ivy* leaves. The most remarkable results, as being, perhaps, the most satisfactory, were obtained from a concentrated infusion made with the green *leaves* of the *lilium tigrinum,* or *tiger lily.* From this infusion, a *gallate of iron* was instantly separated, simply by touching the surface in a test-tube with a glass rod dipped in *tincture of galls,* and afterwards heating the infusion to the boiling point. *Ammonia,* being substituted for the *tincture of galls,* threw down, as before, a more copious precipitate containing *iron.*

I remain, Gentlemen, yours, &c.

Cambridge, Sept. 15, 1818. EDWARD DANIEL CLARKE.

Article VIII.

On Improvements in Printing. By Thomas Gill, Esq.

(To the Editors of the *Annals of Philosophy.*)

No. 11, *Covent Garden Chambers,*
Sept. 14, 1818.

GENTLEMEN,

Having had my attention directed lately to the important arts of letter-press and copper-plate printing, and having obtained a knowledge of several new and useful improvements therein, I shall make no apology for communicating them to the public, through the medium of your *Annals.*

The improvements made in the typographic art by the late Earl Stanhope, and particularly in forming the press of that unyielding substance cast iron, instead of the elastic materials before used, in making the platten and table with truly plane surfaces, and in working the screw by a combination of levers, has given the means of taking off an impression from a much larger surface at once than could ever be done with the old presses; and the art of making paper by machinery in long continued sheets has also afforded another important aid to this object.

This increased size is, however, attended with the inconvenience of causing much greater labour to the pressmen; and it has accordingly been the study of several ingenious mechanics to cause the press to be worked with more ease, and particularly to introduce other contrivances in place of the screw, which, although a powerful agent, moves with very great friction.

Mr. Medhurst was, I believe, amongst the first to substitute another movement, which, however, has never been brought into general use; Mr. Ruthven constituted a new combination of levers; and Messrs. Cogger and Scott, circular inclined planes; and lately an alteration of Mr. Medhurst's contrivance: still, notwithstanding all these endeavours, a great exertion of human strength is required in working these presses.

I am, however, glad to state, that this evil is now in a very great degree alleviated, by the introduction of the *Columbian press,* invented by Mr. George Clymer, of Philadelphia, several of which are now in use in different printing establishments of this metropolis with very great advantages indeed in point of power and ease in working over other presses.

Printing by machinery is also making considerable progress in this country, particularly by Mr. Kœnig's machines at Messrs. Bensley's, Messrs. Taylors', and the Times newspaper printing offices, and by Messrs. Applegart and Cowper's new invented machine.

We are at present, however, outdone by our trans-atlantic *competitors,* insomuch that *the Bible is now printed in North*

America in the very short period of three minutes! This is effected chiefly by the employment of cylinders covered with stereotyped plates, a contrivance which I invented, and endeavoured to get carried into effect in this country upwards of eight years since, and which at length is now, I believe, introducing here by degrees.

Mr. Donkin has much improved the machine for printing by means of types fixed upon the flat sides of revolving polygons, originally invented by Mr. Wm. Smith, the geologist, and Mr. Bacon, of Norwich; and particularly by the introduction of a permanently elastic inking roller, the composition of which is also substituted in other printing houses in the forms of balls and rollers, with very considerable advantages over the usual balls, which, as is well known, are covered with sheep's skin, prepared, and kept in a state of use by a peculiarly offensive process.

I am happy in being enabled to add, that the health and comfort of persons employed in the very laborious business of copper-plate printing may now be very much promoted by the adoption of an improvement recently made by Mr. Ramshaw, of Fetter-lane, and for which he has been very deservedly honoured with the gold Isis medal of the Society of Arts, namely, in heating the copper-plates by means of steam, supplied by one boiler only to many cast iron receptacles with flat tops, on which the plates are laid, and heated with great convenience and uniformity to receive the ink, instead of employing as many open vessels with charcoal constantly burning in them, which, besides destroying the oxygen of the atmospheric air, produced much carbonic acid gas, and consequently very much injured the health of the pressmen, enfeebled them, and rendered them much more liable to ruptures from the violent exertions they are obliged to make in that laborious employment. I am, Gentlemen,

Your most obedient servant,

THOMAS GILL

ARTICLE IX.

ANALYSES OF BOOKS.

Journal of a Residence in the Island of Iceland during the Years 1814, 1815, *&c.* By Ebenezer Henderson.

THE main object of Dr. Henderson's visit to Iceland was to superintend the distribution of a number of copies of the Scriptures, provided for the use of the inhabitants by the British and Foreign Bible Society. For this purpose he made the tour nearly of the whole coast, and crossed two or three times the dreary uninhabitable wastes that occupy the interior of the country. He thus had an opportunity of examining a much larger portion of the island than has fallen under the notice of any modern traveller; and although not, strictly speaking, a man of science, has collected much new and interesting matter relative to its mineral history. The following summary of his observations on this subject will, it is hoped, prove acceptable to the readers of the *Annals*.

From Reykiavik, the capital of the island, Dr. H. undertook three distinct journeys. In the first, he proceeded to the Geysers, then crossing the interior of the island in a N.N.E. direction he arrived at the head of the Eyafiord on the north coast; thence, after a short excursion to the west, he proceeded along the coast in an easterly direction, visited the volcanic neighbourhood of Mount Krabla, traversed the eastern part of the island, and returned to Reykiavik along the whole of the southern coast. His second journey included nearly the whole of the western coast, together with such parts of the north-western as were accessible; and on his return he traversed the interior of the island somewhat to the east of the parallel of Reykiavik. The third journey included the tract between the two former ones.

The central parts of Iceland appear to be wholly uninhabited except by a few roving banditti, the existence of whom, however, of late years, is rather suspected than ascertained. Plains of loose volcanic sand, black rough ridges of lava many miles in length, deserts of loose stones and clay, deeply ploughed by torrents of hot and of cold water, which, during the tremendous convulsions to which the island has been subject, have descended with irresistible fury from the snows and glaciers of the usually inactive volcanoes, cones of a black or lurid red colour exhaling sulphureous vapours, jets of steam and of boiling water, the roaring rush of which is almost the only sound, except that of the tempest, which wakes the echoes of these forlorn solitudes—such is the scenery which composes the interior of the country as far as it is known to the inhabitants of the valleys and of the coasts. Patches of coarse grass and herbage, at intervals of six to 20 miles, just sufficient for a day's sustenance to a score of horses, afford the possibility of traversing these deserts during a few weeks in the summer. The following extract from Dr. Henderson's journal presents the whole scene in all its shuddering reality.

"Next morning we were under the necessity of prosecuting our journey, the horses having eaten all the grass in the vicinity during the night, and we had a ride of more than 30 miles to the next station. During the first three hours, we had rather a tedious ride up the steep ascent covered with broken lava, which extends along the west side of the mountain till we gained its summit, called Blâfells-hâls, where there is a passage between that mountain and the immense chain of ice-mountains in the interior. From this elevation we had a most commanding prospect of the whole level tract of country, which, beginning at Haukadal, and stretching past Skalholt, opens into the extensive plains between Mount Hekla and the sea. Several miles behind Thingvalla lay the large volcanic mountains called Skialdbried and Tindafiall; and between us and this latter mountain a regular chain of high conical mountains commenced, which stretched to a considerable distance along the base of the neighbouring Yökul. The blackness of their appearance formed a *perfect contrast to* the whiteness of the perennial snows behind them. What particularly struck us was the majesty of the vast ice-mountain, which extends from a little to the east of Tindafiall, in a westerly and northerly direction, to the distance of not less than 100 miles across the interior of the island.

"Descending by the west end of Blâfell, which here consists of immense irregular masses of dark brown tuffa, we came again, in the course of a short time, to the Hvitâ, near its egress from a large lake, to which it gives the name of Hvitârvatn. The whole of the western margin of this lake is lined with magnificent glaciers, which, before meeting the water, assume a hue of the most beautiful green. It abounds with excellent fish, and used to be much frequented in former times by the peasants in the south. At the fording-place, the river may be about 100 yards across; and we found it in some places so deep, that our horses were on the point of swimming. It is certainly the most formidable river in this quarter of Iceland; and is often unfordable for weeks together, when travellers, coming from the desert, are not unfrequently reduced to great straits, by the consumption of the food they had provided for their journey.

"On leaving the Hvitâ, we encountered a long tract of volcanic sand, with here and there insulated stones, of an immense size, which must have been erupted from the Kerlingar-fialla volcanoes, situated at the distance of 15 or 20 miles in an easterly direction. Most of these volcanic mountains form beautiful pyramids, and some of them are of a great height, and partially covered with snow. The cone, in the remote distance, is most perfectly formed, and is quite red in appearance, arising from the scoriæ deposited on its sides. None of these volcanoes have ever been explored; nor have I so much as met with their names in any description of the island that I have seen. From the peasant at Holum, who has proceeded several times to the vicinity in search of moss, I learned that a very extensive tract of lava stretches between them and the ancient road, called Spreingi-sand; and at one place he observed much smoke, which he supposed arose from springs of boiling water.

"At four o'clock we came to the Black River (Svartâ), fording which we fell in with an extensive tract, known by the name of the Kialhraun, which has been at least twice subjected to fiery torrents from a volcano in the neighbourhood of Bald-Yökul, if not from the Yökul itself. This lava is upwards of 20 miles in length, and in some places five or six in breadth. Here the road divided: that called Kialvegur, leading to Skagafiord, lay to the left, across the lava; whereas the way to Eyafiord, which we pursued, ran along its eastern margin, now on one side of the Black River, and now on the other. After travelling about eight miles further, over a very stony tract, we came to the station of Grânaness, which we found to be the termination of a very ancient stream of lava, mostly covered with moss and willows, and having only a little grass in the cavities, which have been formed by the bursting or falling in of the crust. Inhospitable as it appeared, we were obliged to stop, as we were exposed to a heavy rain, and the next green spot was about 50 miles distant.

"On the afternoon of Monday, the first of August, we commenced the worst stage on our whole journey. Our road, which at times was scarcely visible, lay along the west side of the Hof, or Arnarfell Yökul, a prodigious ice mountain, stretching from the volcanoes above-mentioned, in a northerly direction, for upwards of 50 miles, when it turns nearly due east, and extends to nearly 30 miles in that direction. We rode at no great distance from it for the space of 20 hours, and were all the time exposed to a cold piercing wind which blew from that quarter. About 11 at night we came to the Blanda, or Mixed River, the waters of which were of a bluish colour, and, dividing into upwards of a dozen of branches, they rendered our passage both tedious and troublesome. Near the north-west corner of the Yökul, a great number of curiously shaped hills presented themselves to our view, which we found, on approaching them, to be partly volcanic and partly immense masses of Yökul, intermixed with drosses and fragments of lava, which have been separated from the mountain during some of its convulsions, and hurled along to their present situation by the inundations it has poured down upon the plains. At 10 minutes before three o'clock in the morning, as we had got quite surrounded by these hills, and were almost shivering with cold (the waters being covered with fresh ice), we were gratified with a view of the sun, rising in all his glory directly before us. The gloom in which we had been involved now fled away; and we obtained a very extensive prospect of the surrounding country. It was a prospect, however, by no means pleasing; for to whatever side we turned, nothing was visible but the devastations of ancient fires, or regions of perpetual frost."

The middle part of the north coast appears to be by far the most fertile; the rivers are larger, the vales broader, the intermediate country less rugged; and the Yökuls, or snowy mountains, are removed to a great distance in the interior. The last remains of the forests of Iceland are in this tract; but they are now fast disappearing in consequence of the improvident destruction made among them by the inhabitants, and the supposed increasing inclemency of the seasons. Stumps of birch trees more than two feet in diameter are still to be met with.

The N.E. quarter of the island is one of the chief volcanic centres, and at present yields nearly the whole of the sulphur which is annually exported from Iceland. The hot springs of Reykiahverf exhibit appearances similar, but inferior in magnificence to those of the geysers in the south-west of the island, and, therefore, need not be presented to our readers. But the description of the scenery in the vicinity of Krabla, the principal volcano of the district, forms, perhaps, the most interesting portion of Dr. Henderson's book, as far at least as the natural history of the country is concerned.

From the little port of Husavik the travellers proceeded in a southern direction till they came upon the Laxârdal, a rugged valley filled with lava, through which the Laxa pursues its irregular course. After passing a few miles over the rough lava, they arrived on the edge of a desert, four hours' journey across, consisting of sand, pumice, and other volcanic substances, wholly destitute of water and of vegetation. Beyond the sand extends a prodigious stream of lava, being one of those which issued from Krabla between the years 1724 and 1730, and inundated nearly the whole of the plain along the northern and eastern shores of the lake Myvatn. It still retains the original freshness of its appearance. In colour, it is as black as jet; the blisters and cracks by which its surface is diversified are of enormous size, and most of the chasms are completely glazed, and present the most beautiful and grotesque stalactitical masses.

At Reykiahlid, one of the farm-houses, over-run by the fiery deluge, but which was afterwards rebuilt on nearly the same spot, the travellers encamped for the night. The view from this place is in an extreme degree savage and desolate. In front is the Myvatn, or Gnat-lake, and the whole of the intervening tract is one vast field of black, rough, and cavernous lava, projecting a considerable way into the lake, and forming innumerable creeks and promontories along the greater part of its northern margin. To the north-west rise a number of barren hills that open into the sandy deserts, leaving which, the eye wanders over an extensive tract of moor, intersected by red conical mountains, till, reaching the south side of the lake, it falls in with several huge mountains of singular forms, and the Nàmar, or sulphur mountains, from which a vast profusion of smoke is constantly ascending. The most profound and death-like silence pervades the whole of this desolated region. The gloom of the lake is greatly augmented by the small black islands of lava with which it is studded; and the pillars of vapour ascending in different parts from the surface of the water remind the observer that the destructive element, which has been the tremendous cause of the surrounding ruin, still lingers there, and may again wake to activity. The lake is reckoned to be about 40 miles in circuit, but is shallow from the floods of lava that have been poured into its basin.

The next morning they resumed their journey towards the sulphur mountains, passing over considerable tracts of lava and volcanic sand, till having arrived in their immediate vicinity, the increase of the exhalations, and the heat and unsoundness of the surface, obliged them to advance with caution over the more indurated parts. With all their care, the feet of their horses occasionally broke through the crust, forming holes through which the vapour issued in great abundance. On either side lay vast beds of sulphur, covered with a thin crust, composed of aluminous efflorescences, which being removed, a thick bed of pure sulphur appeared, through which the steam issued with a hissing noise. The sublimation of the sulphur is caused by the ascent of this vapour, and its abundance and purity depend considerably on the porosity of the subjacent soil. The tract which goes by the name of the Sulphur Mountain is about five miles in length and one mile in breadth, extending between the volcanoes of Krabla and Leirhnukr, and joining the ridge by which these two mountains are connected. The surface is very uneven, displaying large banks of red clay and sulphur, the crust of which is variegated with tints of blue, yellow, and white.

After overcoming with great difficulty the labour, and escaping the dangers of the ascent, they arrived suddenly on the edge of an abrupt descent of more than 600 feet, at the bottom of which lay a row of 12 large cauldrons of boiling mud, roaring, splashing, and sending forth immense columns of dense vapour. By a circuitous route, among numerous boiling hot quagmires, they at length arrived close to the springs. Excepting two which lie a short distance from the rest, they are all crowded into one vast chasm in the lava. Some of them remain stationary, but roar terribly, and emit much steam; others boil violently, and splash their black muddy contents round the orifice of the pit, while two or three jet at intervals to a height of from five to 15 feet.

From this extraordinary scene they passed along the margin of a stream of lava, covered with pumice and volcanic sand to the base of Krabla; and with much difficulty succeeded in making their way over the pumice sand and slippery clay which form the side of the mountain. After an hour's climbing, they arrived at a vast hollow, forming the remains of the crater, in the middle of which lay a circular pool of black liquid matter at least 100 feet in diameter. Nearly about the centre of the pool is an aperture from which a *vast body* of fluid, consisting of water, sulphur and black clay, is thrown up, and which is equal in diameter to the column ejected by the great Geyser at its strongest eruptions. The height of the jets varied greatly, rising on the first propulsions of the liquid to about 12 feet, and continuing to ascend, as it were, by leaps till they gained the highest point of elevation, which was upwards of 30 feet, when they again abated much more rapidly than they rose. While Dr. Henderson continued there, which was about an hour, the eruptions took place every five minutes, and lasted about two minutes and a half.

From Krabla Dr. H. proceeded to the eastern extremity of the island, whence he returned to Reykiavik along the southern coast; and in so doing passed along the narrow and dangerous tract, extending between the sea and the Yökuls, or ice mountains, which occupy the whole interior of the island in this quarter.

The Yökuls are mountainous tracts, varying considerably in elevation, almost the entire surface of which is covered with snow and glaciers. Being perfectly desert, the remote parts of scarcely any of them have been explored; but where they come in contact with the cultivated or inhabited districts, their mischievous and often fatal effects are but too well known. The glaciers of the Alps, according to Saussure and other accurate observers, are often found to encroach somewhat on the adjacent lands and then to retreat, partly in consequence of the vicissitude of the seasons, and partly from the accumulated pressure of the water from the melting of the snow filling the crevices in the ice, loosening more or less its adhesion to the subjacent rock, and pushing before it the mass of the glacier till the water has discharged itself by means of the numerous outlets thus formed, when the glacier again retracts and withdraws nearly to its accustomed limits.

The above phenomenon, which in Switzerland is in general little more than an object of philosophical curiosity, is in Iceland, especially on the southern coast, the occasion at all times of great inconvenience, and occasionally of horrible devastation. The cause of this is in part the enormous accumulation of snow and ice which takes place during the winter in these high latitudes, but principally the circumstance that the mountains on which these glaciers rest are volcanoes. Hence, even in quiet years, the melting of the ice is much more rapid in some parts than in others, and this melting begins from the bottom of the superincumbent mass of ice, which, being thus undermined, subsides with a loud crash, sending forth long cracks in every direction, and pouring out torrents of water, the impetuosity of which bears down huge stones and blocks of ice into the rivers, thus stopping for a time, or rendering excessively dangerous all passage at the fords. In the mean time masses of the glacier, some miles in extent, begin to move forward into the plain, pushing *before them* rocks of considerable magnitude; and in the course *of a few months* will advance half a mile or more, after which they retract, but seldom so far as to recover their original situation, leaving a face of rock or a waste of stones on which no soil can ever after accumulate, and which, therefore, is lost to the inhabitants. The following was the appearance of Breidamark Yökul when Dr. Henderson passed by it.

> "All along the margin, and a considerable way back, were deep indentations, and, in some places, chasms of an immense size, that penetrated further than the eye could reach, and in which I could hear the distant dashing of the water as it fell from the surface of the Yökul. The margin consisted, for the most part, of large flat pieces of ice lying in all directions: sometimes it was as perpendicular as a wall; at others, the ice lay horizontally, forming vast crystal grottoes; and, what particularly struck me, was a number of small cavities and cells, in such parts of the surface of the ice as were not exposed to the sun, which were filled with the most beautiful pyramidic crystals, from a quarter of an inch, to an inch and a half in diameter. In some places, the interior of the grottoes was completely studded with these crystal groups, sparkling with a dazzling lustre, and assuming various hues, according as they were more or less exposed to the light.
>
> "Towards the bottom of the slope, the ice has collected so much sand and clay, that it assumes a black and dark grey colour: higher up, where the heat of the sun has less influence, the winter snows remain undissolved, and give the Yökul a whiter appearance; and, what is remarkable, at some distance from the margin, a vast number of round pillars, resembling sugar-loaves, only more pointed at the top, begin to rise above the surface, and extend back to the regions of snow. They are quite black in appearance, and may be from three to 20 feet in height. Where the Yökul has pushed forward in one direction and again receded, large heaps of clay, sand, and turf, are thrown up, so as to form a catenation of small hills round its base; but where its progress is continuing, no such hills are seen; only furrows are laid open in the sand, by the sharp projecting pieces of ice, and the sand is raised, precisely as the ground by a plough, to either side. In some places, I could plainly observe the motion of the sand; but whether it arose from the actual progress of the Yökul, or merely from the dissolution of the ice, I shall not determine."

Occasionally the Yökul volcanoes wake to activity, and then the destructive effects of an ordinary volcano are combined and heightened tenfold by the immense deluges of cold and of hot water which are then produced. Four times during the last century, namely in 1727, 1753, 1755—6, and 1783, has this part of the island been thus desolated. With the following description of the last of these awful visitations, we shall conclude our extracts from this interesting work.

> "About a month previous to the commencement of the eruption, a submarine volcano burst forth at the distance of nearly 70 miles in a south-west direction from Cape Reykianess in Guldbringe Syssel, and ejected such an immense quantity of pumice, that the surface of the ocean was covered with it to the distance of 150 miles, and the spring ships considerably impeded in their course.
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> "The Skaptâr volcano, so called from the river of the same name, down which the greater part of the lava was poured, is situated close to the eastern boundary of West Skaftafell's Syssel, about 32 British miles due north of Kyrkiubæ Abbey, and near the contiguous sources of the rivers Tûnâ, Skaptâ, and Hverfisfliot. It lies principally in the valley called Varmârdal, and consists of about 20 red conical hills, stretching in nearly a direct line, from E.N.E. to W.S.W. which have served as so many furnaces, from which the melted matter has been discharged into the valley. From these craters the lava has flowed which inundated the low country, through the channel of the Skaptâ. What flowed down the Hverfisfliot, has had its source in some other craters situated further to the north-east, but which are evidently connected with the former hills, and would, in all probability, have poured their contents down Varmârdal, had it not been completely filled with the lava, which had already been emptied into it.
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> "From the 1st to the 8th of June, 1783, the inhabitants of West Skaftafell's Syssel were alarmed by repeated shocks of an earthquake, which, as they daily increased in violence, left no reason to doubt that some dreadful volcanic explosion

was about to take place. Pitching tents in the open fields, they deserted their houses, and awaited, in awful suspense, the issue of these terrifying prognostics. On the morning of the 8th, a prodigious cloud of dense smoke darkened the atmosphere, and was observed to be continually augmented by fresh columns arising from behind the low hills, along the southern base of which, the farms, constituting the parish of Sida, are situated. A strong south wind prevented the cloud from advancing over the farms; but the heath, or common, lying between them and the volcano, was completely covered with ashes, pumice, and brimstone. The extreme degree to which the earth in the vicinity of the volcano was heated, melted an immense quantity of ice, and caused a great overflow in all the rivers originating in that quarter.

"Upon the 10th, the flames first became visible. Vast fire-spouts were seen rushing up amid the volumes of smoke, and the torrent of lava that were thrown up, flowing in a south-west direction, through the valley called Ulfarsdal, till it reached the river Skaftá, when a violent contention between the two opposite elements ensued, attended with the escape of an amazing quantity of steam; but the fiery current ultimately prevailed, and, forcing itself across the channel of the river, completely dried it up in less than 24 hours; so that, on the 11th, the Skaptá could be crossed in the low country on foot, at those places where it was only possible before to pass it in boats. The cause of its desiccation soon became apparent; for the lava, having collected in the channel, which lies between high rocks, and is in many places from 400 to 600 feet in depth, and near 200 in breadth, not only filled it up to the brink, but overflowed the adjacent fields to a considerable extent; and, pursuing the course of the river with great velocity, the dreadful torrent of red-hot melted matter approached and laid waste the farms on both sides. In the mean time, the thunder, lightning, and subterraneous concussions were continued with little or no intermission; and besides the crackling of the rocks and earth, which the lava burned in its progress, the ears of the inhabitants were stunned by the tremendous roar of the volcano, which resembled that of a large caldron in the most violent state of ebullition, or the noise of a number of massy bellows, blowing with full power into the same furnace.

"The torrents that continued to be poured down proceeded slowly over the tract of ancient lava to the south and south-west of Skál, which underwent a fresh fusion and was heaved up to a considerable elevation. It also rushed into the subterraneous caverns, and during its progress under ground, it threw up the crust either to the side, or to a great height in the air. In such places as it proceeded below a thick indurated crust, where there was no vent for the steam, the surface was burst in pieces, and thrown up with the utmost violence and noise to the height of near 180 feet.

"On the 18th another dreadful ejection of liquid and red-hot lava proceeded from the volcano, which now entirely covered the rocks that had towered above the reach of the former floods, during their progress through the channel of the Skaptá, and flowed down with amazing velocity and force over the masses that were cooling, so that the one stream was literally heaped above the other. Masses of flaming rock were seen swimming in the lava. The water that had been dammed up on both sides of its course was thrown into a violent state of ebullition, and overflowing its boundaries, it did great damage to the grounds of Svinadal and Hvammur, which farms had already been attacked by the edge of the lava, as also to the underwood of Skaptárdal on the east.

"Continuing its progress the following day, the lava divided into two streams, one of which flowed with the same velocity as the day before due south, along the river Melquisl into Medelland; while the other took an easterly direction over the parish of Sida, burning the tract about Skálarstapa, and running with inconceivable force from thence to Skálarfiall, by which it was prevented from spreading further north. But, rising on the hill, it rolled up the soil before it, and approached within 120 feet of the church and houses of Skál, and overran the whole tract between that place and Hollt. As Skál had now escaped the fury of two successive floods of lava, sanguine hopes were entertained of its safety; but a great quantity of rain having fallen on the 21st, and swelled the water already dammed up in the valley, the church, the parsonage, and out-houses, were completely overflowed; and the whole tract was observed the following morning to be covered with water in a state of violent ebullition.

"While these awful devastations were going forward in the divisions of Skaptártunga, Medalland, Lándbrot, and Sida, the only inconveniences felt by the inhabitants of Fliotshverfi were the destruction of vegetation by the showers of red-hot stones and ashes which fell upon it, and the impregnation of the atmosphere and water with mephitic substances. They had, indeed, twice been enveloped in almost total darkness, especially on the 28th of June, when it was so thick, that it was scarcely possible at noon day to distinguish a sheet of white paper, held up at the window, from the blackness of the wall on either side; but they flattered themselves in the hope that the lava would soon all be ejected, and at all events that it would continue to flow in the direction it had originally taken. However, on the 3d of August, they were alarmed by a quantity of smoke, which they observed arising out of the river Hverfisfliot; and as the heat, which was also found to be in the water, daily increased, till at last the river was totally dried up, they concluded that the same destruction was about to be poured down upon them which had overwhelmed the parishes to the west.

"Nor were their apprehensions without foundation; for the floods of lava having entirely choked up the Skaptâ, and all the low channels to the west and north of the volcano, it was forced to assume a new course, and running in a south-east direction, between Mount Blængur and Hverfisfliot, it was discharged at length into that river, which occasioned vast volumes of steam and smoke to arise from that quarter, attended with dreadful noises and lightnings. The burning flood now ran down the empty channel, and filling it to the brink overflowed the low grounds on both sides; and, by the evening of the 9th, it had not only reached the outlet into the open and level country, but in the course of a few hours had spread itself to the distance of nearly six miles across the plain, and stopped up the road between Fliotshverfi and Sida. The volcano still continuing to send forth fresh supplies of lava, the red-hot flood spread itself wider and wider, and in its progress destroyed the farms of Eystradal and Thverârdal, the houses, meadows, and neighbouring grounds of which are so completely covered, that the spot where they lay is no longer visible. It also did considerable injury to the farms Selialand and Thverâ, and obliged their inhabitants, as well as the whole parish of Kâlfafell, to flee for their safety; yet the above-mentioned were the only houses it burned. Though this branch ceased to extend over the low country after the end of August, quantities of fresh lava continued still to be thrown up out of the volcano, and a new eruption is said to have taken place so late as the month of February, 1784, during the greater part of which year columns of smoke were observed to ascend from many parts in the lava; and it had not quite cooled for nearly two years after the eruptions were over.*

"With respect to the dimensions of the lava, its utmost length from the volcano, along the channel of the Skaptâ down to Hnausar, in Medalland, is about 50 miles, and its greatest breadth in the low country between 12 and 15 miles; the Hverfisfliot branch may be about 40 miles in length, and seven at its utmost breadth. Its height in the level country does not exceed 100 feet; but in some parts of the Skaptâ channel it is not less than 600 feet high.+"

ARTICLE X.

SCIENTIFIC INTELLIGENCE, AND NOTICES OF SUBJECTS CONNECTED WITH SCIENCE.

I. *Lectures.*

Mr. Cooper will commence his autumn course of lectures on Practical Chemistry at his house, 89, Strand, on Tuesday, Oct. 13, at eight o'clock in the evening.

Dr. Stephenson will commence a course of lectures on Natural History, on Wednesday, Oct. 14. The plan of the course is intended to embrace a general outline of the science of Natural History.

Mr. Mac Kenzie commences his next course of lectures on the Diseases and Operative Surgery of the Eye, Oct. 5, at nine o'clock in the morning, on Mondays, Wednesdays, and Fridays, at 16, Newman-street, Oxford-street.

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* When Mr. Paulson visited this tract in the year 1794, he found a column of smoke still arising from certain parts of the lava; and some of the rents were filled with hot water.

+ *Chief Justice Stephensen's* description of the Eruption of 1783, altered *according to Mr. Paulson's* MS.

II. *On the Proteus anguinus.*

This singular animal supposed to be a native only of the lake of Sittich in Carniola, whence, in times of flood, it escaped into the *Cirknitzer see,* and which was generally considered as the larva of some unknown amphibious animal, has lately been the subject of an interesting letter from M. Rudolphi to Professor Linck.

According to M. Rudolphi it has recently been discovered in the grotto of St. Madelaine, near Adelsberg, and in some other small lakes, or pools, in the vicinity, in sufficient abundance to have enabled him to procure 14 individuals.

The manners and habitudes of this animal bear a great resemblance to those of the salamanders. Although the eyes of the proteus are very small, and covered by a skin of considerable thickness, the animal appears very sensible to light, and its motions, when thus exposed, are very brisk; the veins, also, beneath the transparent skin of the animal become at the same time very turgid. Although capable of enduring so long continued an abstinence that it was generally supposed to take no solid food, M. Rudolphi has found in the stomachs of a few of them the remains of snails and of other small animals.

The irritability and muscular power of the proteus are very feeble. The globular particles of the blood are larger than in any other known animal, and its lungs are a sac much resembling the air bladder of fishes; which structure admitting only of a very slow decarbonization of the blood, appears to account for the very singular anomaly of the conjunct action of lungs and gills in the same individual.

Cuvier, who some years ago dissected a specimen of the proteus, demonstrated in it the presence of ovaries, thus rendering the opinion of its being a perfect animal and not a larva extremely probable. This observation has been fully confirmed by M. Rudolphi, who, in some individuals, has detected ovaries, and in others testicles.

III. *Notice concerning certain Minerals lately discovered.*

Several minerals have recently been discovered in the valley of Fassa, in the Tyrol, and in different parts of Germany, which, by Werner and his pupils, have been regarded as distinct species. Specimens of these having been sent to M. Haüy, were examined by him and by M. Cordier, the latter of whom has published a paper on the subject (Ann. des Mines for 1818, p. 1), from which the following particulars are extracted.

Albin.—This mineral, so called by Werner from its white *colour, occurs* at Mariaberg, near Aussig, in Bohemia, imbedded *in clinkstone.* It forms tubercular masses lining or filling cavities, and exhibiting superficially right prisms with square bases terminated by truncated pyramids, the faces of which are placed on the angles of the prism. The structure of the grains is granularly foliated with joints parallel to the bases. The colour both of the grains and crystals is an opaque white. When digested in hot nitric acid, it soon gelatinizes, and the same effect takes place in cold acid after a few days. From these characters it is manifest that this supposed new species is only a variety of mesotype.

Egeran.—This substance has been so named by Werner from the place where it was discovered, Eger, in Bohemia. Its gangue is a grey quartz covered in part with tremolite. It occurs in the form of small, nearly opaque crystals, of a deep brown colour. The form of the crystals is a right rectangular prism, each longitudinal edge of which is replaced by a facette forming an angle of 135° with the two adjacent sides. It possesses natural joints parallel to the four principal sides and to the bases; before the blow-pipe it melts into a black scoria. Hence it is clear that this supposed new mineral is idocrase.

Gehlenite.—So named by M. Fuchs in honour of the chemist Gehlen. It was discovered in the valley of Fassa, and has the form of small rectangular crystals, sometimes single, often imbricated, disseminated in a gangue of lamellar calcareous spar. The form of the crystals is a right prism with square bases, so low as to be almost tabular. The colour is grey with a greenish or yellowish tinge. The surface is dull, rough to the touch as if corroded. The crystals are opaque, or nearly so, and somewhat inferior in hardness to quartz. The fracture is uneven, passing to splintery, with indications of joints parallel to the bases. Specific gravity, 2·98. Before the blow-pipe it melts into a brownish yellow transparent glass, which soon becomes opaque and scoriform when acted on by the interior part of the flame.

It is to be remarked that the crystals are often traversed by minute veins of calcareous spar, and when reduced to impalpable powder, the mineral dissolves in muriatic acid, and the solution gelatinizes. The same property has been observed by M. Cordier in the idocrase of Barreges, which occurs also in a calcareous base. Hence M. Cordier is induced to regard the gehlenite as a variety of idocrase.

Helvin.—This substance, so named by Werner, was discovered in the mine of Schwartzenberg, in Saxony. It occurs in a blackish green chlorite mixed with blende and fluor, in the form of minute disseminated irregular octohedrons, of a pale yellowish brown colour. Its fracture offers no indication of natural joints. It is softer than glass, and melts easily before the blow-pipe into a blackish brown glass. The mineral acids when cold appear to have no action on its powder.

Pelium.—So named by Werner, was discovered at Bodenmais, in Bavaria. It occurs imbedded in grey granite, in crystalline grains either solitary or aggregated. The form is that of a regular hexahedral prism truncated on the edges and angles. In form and other characters it perfectly resembles the dichroïte of Cape de Gatte, and of India.

Pyrgom.—By this name, Werner distinguishes the mineral found in the valley of Fassa, and to which the name of fassaïte had already been given by the Italian mineralogists. In its crystallization, its structure, and other essential characters, it perfectly agrees with augite (pyroxène of Haüy).

IV. *On Sirium, a supposed New Metal.*

A new metal is said to have been discovered by Prof. West, or Vest, of Gratz, to which he gives the name of Sirium, a specimen of which has been sent over to this country. This, however, we learn, upon being examined by Dr. Wollaston, proves to be a compound, consisting essentially of a sulphuret of nickel and cobalt, with a minute quantity of iron, and exhibiting also a trace of arsenic.

In the Annales de Chimie et de Physique for May, there is an account of this supposed metal from an anonymous correspondent at Vienna, accompanied by some observations from the editor; a translation of which will, we trust, prove interesting to our readers.

This metal is procured from the nickel mine of Schladminger, where it is found united to a large quantity of arsenic and nickel, with a little cobalt and iron. After having melted the ore in a crucible with glass, it is pulverized and dissolved in nitric acid; the excess of acid is saturated, and the acetate of lead is then added: an arseniate of lead is precipitated, but a portion of arsenic still remains in solution. The excess of lead is separated by sulphate of soda, the fluid is filtered, and a little acid is added, which is necessary to obtain the Sirium in a state of purity. After having passed a current of sulphuretted hydrogen through the solution, it is neutralized by carbonate of potash, until a flocculent precipitate is formed, which is not re-dissolved: if we then pass a second current of sulphuretted hydrogen through the solution, the Sirium is precipitated in combination with sulphur. It is an essential character of this metal not to be precipitated from its solutions by sulphuretted hydrogen, when they contain an excess of acid, but to be precipitated when they are not in this state. The green fluid, from which the Sirium has been precipitated, contains nickel, cobalt, and iron.

If the dried sulphuret of Sirium be heated in a crucible lined with charcoal, we obtain a black scorified mass with a metallic fracture. This mass is pulverized, $\frac{1}{5}$ of its weight of oxide of arsenic is added to it, and it is heated for half an hour at a temperature of about 60° W. The discoverer of this metal, M. Vest, procured, *in one experiment*, a spongy regulus; and in another, a compact regulus, which consisted of the Sirium still containing sulphur, arsenic, nickel, and iron, in consequence of the filter not having been sufficiently well washed.

Remark of the Editor.—The above is the account of the discovery which has been transmitted to us, and which, as we are assured, has excited much attention among the Austrian philosophers. The author of the letter may have omitted some important particulars; for, as it now stands, nobody can give credit to M. Vest's Sirium, but must rather be impressed with his want of experience. As he appears not to know that nickel is not precipitated from its solutions by sulphuretted hydrogen, when they are acid, and that it is partially precipitated when they are neutral, we must beg him to repeat his experiments in order to discover whether his Sirium be not merely very impure nickel.

V. *Notice on Picrotoxine, considered as a new Vegetable Alkali.*

By M. Boullay.*

The term picrotoxine has been employed by M. Boullay to express the acrid, narcotic principle, to which the cocculus indicus, the fruit of the Menispermum cocculus, owes its poisonous qualities.† This principle he conceives is analogous to the morphium, which has been detected in opium, and which appears to constitute the active ingredient in that drug; and he further supposes, that there are other vegetables which contain substances that may all be regarded as belonging to the same genus.

A strong infusion of the seeds of the Menispermum cocculus, to which ammonia had been added in excess, precipitated by degrees the picrotoxine in the form of a white, granulated, and crystalline powder. This precipitate, after being washed, is partially dissolved by alcohol without colouring it, and is separated from it by the spontaneous evaporation of the alcohol, in the form of very beautiful silky needles.

A strong infusion of 100 parts of these seeds in alcohol, gently evaporated to ¼ of its bulk, had 10 parts of calcined and well-washed magnesia added, and was boiled for a quarter of an hour. The filtered fluid, which was powerfully acid before the addition of the magnesia, was then found to be sensibly alkaline by its action upon litmus paper and the tincture of rhubarb. A greyish deposit was collected upon the filter, which, after being lixiviated and treated with boiling alcohol, produced crystals of the same nature with those obtained in the former experiment, except that they were a little less white.

The picrotoxine which was obtained in these experiments had only a weak action on vegetable colours; but it readily dissolved in acids, neutralizing them, and forming with them proper saline compounds; it is, therefore, especially from its property of saturating acids, like salifiable bases, that this bitter principle derives its claim to be considered as an alkali. The same remark applies to morphium when it is in a perfectly pure state.

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* *Abstracted from Journ. Pharm. iv. 367. (Aug. 1818.)*

† *Thomson's Chemistry, iv. 55. (Fifth Edit.)*

M. Boullay remarks that the *bitter narcotic* principle which he first obtained pure and crystallized, and which appears to possess the properties of an alkali of vegetable origin, forms a new class of bodies, of which it is probable we shall detect many species. MM. Pelletier and Caventou have just discovered an alkali in Nux vomica, and the bean of St. Ignatius, which probably must be referred to this head.

The acid which appears to be naturally combined with the picrotoxine, in the form of a super-salt, is supposed by the author to be of a peculiar nature; it appears to differ from the meconic acid; but this he proposes to make the subject of further investigation hereafter.

VI. *Extract from a Notice read to the Academy of Sciences, Aug. 10, respecting the Discovery of a New Alkali.*

This notice relates to the discovery made by MM. Pelletier and Caventou, which is referred to in the last article. We are informed, that in analyzing the Nux vomica and St. Ignatius's bean, they met with a new vegetable alkaline substance, which is conceived to compose the active principle of these bodies. Its chemical properties are as follows.

It is slightly soluble in water, very soluble in alcohol, restores the colour of turnsole after it has been reddened by an acid, does not redden turmeric, combines with acids, which it saturates, and forms with them crystallizable salts.

The discoverers have given this substance the name of *vauqueline*, in honour of the celebrated chemist, who was their preceptor, and who is said to have first discovered the alkaline properties of a vegetable substance which he procured from the daphne alpina. The authors remark that the alkali from the Nux vomica and from the Daphne, together with the picrotoxine of M. Boullay, and morphium, will form the first genera of a new class of vegetable principles.

VII. *On the Existence of Boracic Acid in Tourmaline and in Axinite.* By M. Vogel.

The existence of the boracic acid in tourmaline and axinite was announced by M. Vogel to the Royal Society of Munich, in July last, as we learn from the number of the Journ. de Pharm. for August, which we have just received.

After remarking upon the uncertainty which still attaches to the composition of the tourmaline, M. Vogel gives an account of the method which he adopted to procure the boracic acid in a separate state: he declines detailing the complete analysis of this mineral, because M. Gmelin of Tubingen is now engaged in this investigation.

154·44 gr. (10 grammes) of black tourmaline, from the Upper

Palatinate, were kept at a red heat in a platinum crucible with three times their weight of potash; the porous mass, which was of a greenish brown colour, was well washed with boiling water, so as to separate the soluble matter from the oxide of iron and the earths which are insoluble in potash. The alkaline fluid when filtered was slightly supersaturated by sulphuric acid, in order to convert the earths into sulphates, and to decompose the borate of potash which might have been formed at a red heat.

The fluid was evaporated to dryness, and the pulverulent residuum treated with boiling alcohol, which has no action upon the sulphate or the silex.

The alcoholic solution when filtered was observed to burn with a green flame. Having been evaporated to dryness, and the residuum heated in a platinum crucible to drive off the free sulphuric acid, a white substance remained which, when dissolved in boiling water, deposited by cooling scales of a white pearly appearance, which were vitrifiable by a red heat, and exhibited all the properties of boracic acid.

M. Vogel also found boracic acid in a specimen of tourmaline brought from Madagascar, which had been formerly given him by M. De la Metherie.

If we wish to know, by a single operation, whether a mineral contains boracic acid, it is only necessary to boil it for some time in a crucible of platinum with twice its weight of concentrated sulphuric acid; the residuum, when nearly dried, is to be washed with warm alcohol, which will burn with a green flame if the substance contains boracic acid.

Experiments similar to those made with tourmaline have enabled M. Vogel to detect the boracic acid in axinite from Dauphiné.

M. Vogel informs us, that in a late number of Gilbert's Ann. der Phys. there is a letter from Lampadius, in which it is said that tourmaline contains boracic acid; but we have no particulars given on the subject.

We are informed that M. Arfvedson has procured boracic acid from tourmaline in combination with lithina.

* * *

The readers of the Annals are informed, that for reasons which it is unnecessary to obtrude upon the public, Mr. Aikin and Dr. Bostock from this time cease to have any connexion with the work. The last twelve numbers have been entirely edited by them; and, therefore, whatever responsibility has been incurred during this period falls upon them alone. The Editorship will now be resumed exclusively by Dr. Thomson.

Article XI.

Astronomical, Magnetical, and Meteorological Observations.

By Col. Beaufoy, F.R.S.

Bushey Heath, near Stanmore.

Latitude 51° 37′ 42″ North. Longitude West in time 1′ 20·7″.

Astronomical Observations.

Aug. 8.	Emersion of Jupiter's first satellite	9h	34′	12″	Mean Time at Bushey.
		9	35	33	Mean Time at Greenwich.
20.	Emersion of Jupiter's third satellite	8	54	53	Mean Time at Bushey.
		8	56	14	Mean Time at Greenwich.
31.	Emersion of Jupiter's first satellite	9	49	23	Mean Time at Bushey.
		9	50	44	Mean Time at Greenwich.

Magnetical Observations, 1818. — *Variation West.*

Month.	Morning Observ.					Noon Observ.					Evening Observ.				
	Hour.		Variation.			Hour.		Variation.			Hour.		Variation.		
Aug. 1	8h	30′	24°	34′	22″	1h	25′	24°	44′	29″	7h	20′	24°	37′	15″
2	8	30	24	35	43	1	25	24	47	32	7	25	24	35	15
3	8	30	24	35	18	1	35	24	48	25	7	25	24	37	52
4	8	30	24	34	56	1	25	24	48	10	7	25	24	38	55
5	8	35	24	36	49	1	20	24	45	12	7	25	24	37	30
6	8	20	24	34	52	1	25	24	46	06	7	20	24	37	47
7	8	30	24	34	05	1	25	24	44	51	7	20	24	37	10
8	8	25	24	34	09	1	25	24	44	44	7	20	24	38	17
9	8	25	24	34	34	1	25	24	46	59	7	25	24	37	54
10	8	25	24	33	56	—	—	—	—	—	—	—	—	—	—
11	8	40	24	39	58	1	25	24	45	02	7	35	24	39	23
12	8	30	24	35	41	1	20	24	45	01	—	—	—	—	—
13	8	35	24	36	32	1	25	24	45	18	7	25	24	37	00
14	8	25	24	33	55	1	25	24	46	10	7	20	24	36	47
15	8	25	24	33	10	1	20	24	47	41	—	—	—	—	—
16	8	30	24	34	10	1	35	24	47	06	7	25	24	39	02
17	8	25	24	34	18	1	25	24	48	29	7	05	24	38	27
18	8	25	24	32	43	1	25	24	46	37	7	20	24	39	06
19	8	30	24	35	37	1	20	24	47	26	7	20	24	37	02
20	8	25	24	32	22	1	20	24	43	02	7	15	24	36	36
21	8	25	24	34	07	1	30	24	51	30	7	20	24	38	02
22	8	30	24	35	46	1	30	24	46	21	7	05	24	38	12
23	8	25	24	34	18	1	25	24	47	12	7	05	24	37	32
24	8	25	24	35	19	1	25	24	45	34	7	05	24	38	05
25	8	30	24	34	42	1	25	24	45	59	7	05	24	37	36
26	8	25	24	31	35	1	30	24	42	41	7	05	24	37	20
27	8	25	24	35	02	1	20	24	46	32	—	—	—	—	—
28	8	25	24	32	45	1	15	24	40	39	7	05	24	36	46
29	8	30	24	42	10	1	25	24	46	43	7	10	24	37	30
30	8	25	24	34	43	1	30	24	44	52	7	05	24	38	16
31	8	30	24	34	18	1	25	24	48	13	7	05	24	40	56
Mean for Month.	8	28	24	34	40	1	25	24	45	58	7	16	24	37	50

In taking the monthly mean of the observations, those on the *morning* of the 29th and noon of the 21st are rejected, being so *much in* excess, for which there was no apparent cause.

Meteorological Observations.

Month.	Time.	Barom.	Ther.	Hyg.	Wind.	Velocity.	Weather.	Six's.
Aug.		Inches.				Feet.		
1	Morn....	29·548	62°	50°	W by N		Cloudy	55½
	Noon....	29·578	66	42	WNW	—	Cloudy	67
	Even	29·625	62	40	WNW		Cloudy	54
2	Morn....	29·700	59	42	NE		Very fine	
	Noon....	29·713	69	29	NNE	4·134	Very fine	71½
	Even	29·690	62	30	NE		Very fine	53
3	Morn....	29·690	61	40	SE		Very fine	
	Noon....	29·654	72	30	Var.	4·391	Cloudy	75
	Even	29·652	67	33	Var.		Fine	58
4	Morn....	29·670	67	40	Var.		Very fine	
	Noon....	29·670	80	23	Var.	2·793	Very fine	81½
	Even	29·685	72	30	Calm		Fine	63
5	Morn....	29·658	73	30	SSE		Clear	
	Noon....	29·657	86	16	S	9·810	Clear	87½
	Even	29·640	78	19	S		Clear	68
6	Morn....	29·630	74	27	NNW		Very fine	
	Noon....	29·635	81	25	N	9·238	Cloudy	82
	Even	29·650	70	34	NNE		Cloudy	—
7	Morn....	29·650	60	48	NNW		Very fine	
	Noon....	29·650	69	38	NNW	8·044	Very fine	71
	Even	29·647	66	30	WNW		Fine	58
8	Morn....	29·654	65	43	Var.		Fine	
	Noon....	29·654	71	34	Var.	2·959	Fine	73
	Even	29·618	67	33	Calm		Fine	61
9	Morn....	29·563	65	42	E by S		Rain	
	Noon	29·540	76	27	E by S	—	Fine	79
	Even	29·500	69	30	E by N		Fine	59
10	Morn....	29·500	64	45	NNE		Cloudy	
	Noon....	—	—	—	—	11·393	—	72
	Even	—	—	—	—		—	49
11	Morn....	29·753	61	35	NE		Very fine	
	Noon....	29·747	70	25	E	10·447	Cloudy	71½
	Even	29·740	60	31	E		Fine	50
12	Morn....	29·666	61	41	ENE		Cloudy	
	Noon....	29·668	70	31	ENE	14·561	Fine	71
	Even	—	—	—	—		—	51
13	Morn....	29·690	63	37	ENE		Very fine	
	Noon....	29·710	70	25	ENE	11·859	Fine	73½
	Even	29·700	64	31	E		Fine	51
14	Morn....	29·685	60	38	NE by N		Very fine	
	Noon....	29·680	64	34	NNE	8·332	Cloudy	66
	Even	29·665	58	40	NNE		Cloudy	54
15	Morn....	29·647	58	49	NNE		Cloudy	
	Noon....	29·645	62	36	NNE	4·979	Cloudy	65
	Even	—	—	—	—		—	54
16	Morn....	29·668	57	34	NW by N		Cloudy	
	Noon....	29·665	67	26	Var.	—	Fine	69½
	Even ...	29·645	62	27	Calm		Very fine	53
17	Morn....	29·623	61	45	Calm		Fine	
	Noon....	29·600	70	27	NW	3·561	Fine	72
	Even	29·594	63	31	NNW		Cloudy	52
18	Morn....	29·552	60	43	NE		Clear	
	Noon....	29·523	70	26	Var.	4·011	Fine	72
	Even	29·525	58	43	NE		Fine	

Meteorological Observations continued.

Month.	Time.	Barom.	Ther.	Hyg.	Wind.	Velocity.	Weather.	Six's.
Aug.		Inches.				Feet.		
19	Morn....	29·505	56°	44°	NNE		Fine	50°
	Noon....	29·510	63	33	NNE	9·832	Cloudy	64
	Even	29·562	57	34	NE		Cloudy	49½
20	Morn....	29·614	56	43	NW by W		Cloudy	
	Noon....	29·615	62	33	NW by W	8·753	Cloudy	64½
	Even....	29·625	60	32	WNW		Fine	52
21	Morn...	29·625	64	43	NNW		Cloudy	
	Noon....	29·625	64	30	Var.	4·204	Cloudy	66
	Even	29.620	59	35	Var.		Rain	48
22	Morn....	29·610	55	35	NNW		Cloudy	
	Noon....	29·640	61	28	NNW	6·708	Cloudy	63
	Even	29·672	56	30	NNE		Fine	44
23	Morn....	29·770	54	42	N		Fine	
	Noon....	29·770	66	28	N by E	5·622	Fine	68
	Even ...	29·767	61	35	NW by W		Cloudy	56
24	Morn....	29·754	59	37	W		Cloudy	
	Noon....	29·728	64	30	W by N	7·952	Cloudy	65½
	Even	29·687	59	33	WSW		Fine	54
25	Morn....	29·658	59	44	WNW		Cloudy	
	Noon....	29·665	66	30	W	6·161	Fine	68
	Even	29·665	61	30	Calm		Cloudy	52½
26	Morn....	29·584	58	38	W		Sm. rain	
	Noon....	29·546	64	34	WSW	11·650	Showery	67
	Even....	29·513	62	34	WNW		Cloudy	55
27	Morn....	29·420	58	42	W by S		Cloudy	
	Noon....	29·341	61	58	SSW	11·126	Showery	62
	Even....	29·290	—	64	W by S		Showery	58
28	Morn....	29·245	63	52	W		Fine	
	Noon....	29·255	68	35	W by N	23·029	Cloudy	69
	Even....	29·393	62	36	W by N		Cloudy	51
29	Morn....	29.527	61	50	W		Fine	
	Noon....	29·538	73	28	W	10·564	Fine	74
	Even	29·538	66	35	W		Fine	57
30	Morn....	29·457	62	46	WSW		Cloudy	
	Noon....	29·457	70	28	W	9·224	Fine	72
	Even	29·515	61	28	WNW		Cloudy	51
31	Morn....	29·570	58	34	S by W		Very fine	
	Noon....	29·515	68	22	SSE	6·765	Very fine	70½
	Even....	29·453	62	25	S		Very fine	

Rain, by the pluviameter, between noon on the 1st of Aug. and noon on the 1st of Sept. 0·491 inches. The quantity that fell on the roof of my observatory, during the same period, was 0·457 inches. Evaporation, between noon the 1st of Aug. and noon the 1st of Sept. 7·03 inches.

ARTICLE XII.

METEOROLOGICAL TABLE.

1818.	Wind.	Barometer.			Thermometer.			Hygr. at 9 a. m.	Rain.	
		Max.	Min.	Med.	Max.	Min.	Med.			
8th Mon.										
Aug. 23	N	30·20	30·15	30·175	66	58	62·0	50		☽
24	S W	30·15	30·07	30·110	71	56	63·5	42		
25	N W	30·07	29·95	30·010	72	50	61·0	45		
26	N W	29·95	29·75	29·850	75	55	65·0	47		
27	W	29·75	29·60	29·675	68	60	64·0	43	10	
28	N W	29·94	29·65	29·795	73	53	63·0	52		
29	W	29·94	29·86	29·900	80	58	69·0	48		
30	W	30·00	29·86	29·930	76	40	58·0	52	—	○
31	E	30·00	29·49	29·745	75	55	65·0	50		
9th Mon.										
Sept. 1	S W	29·70	29·49	29·595	74	49	61·5	50	2	
2	S W	30·07	29·70	29·885	71	50	60·5	52	—	
3	S W	30·05	29·92	29·985	71	61	66·0	48	—	
4	S	29·99	29·96	29·975	75	63	69·0		9	
5	W	29·96	29·70	29·830	68	55	61·5	66	95	
6	W	29·85	29·70	29·775	69	55	62·0	65	2	
7	N W	29·92	29·85	29·885	64	45	54·5	46		☾
8	Var.	29·90	29·60	29·750	65	40	52·5	60	—	
9	N W	29·68	29·59	29·635	63	43	53·0	65	1	
10	N E	29·85	29·68	29·765	61	39	50·0			
11	N W	30·00	29·85	29·925	60	42	51·0			
12	N W	30·20	30·00	30·100	66	48	57·0			
13	N	30·30	30·20	30·250	68	41	54·5			
14	S W	30·25	29·75	30·000	67	58	62·5			●
15	S W	29·75	29·60	29·675	59	43	51·0	50	25	
16	N W	30·10	29·60	29·850	56	39	47·5	60	12	
17	N	30·20	30·05	30·125	57	41	49·0	57		
18	N W	30·05	29·85	29·950	63	51	57·0	72	—	
19	S	29·85	29·58	29·715	67	50	58·5		2	
20	S E	29·58	29·38	29·480	61	44	52·5	60	—	
21	S E	29·63	29·32	29·475	69	49	59·0	70	13	
		30·30	29·32	29·860	80	39	58·68	54	1·71	

The observations in each line of the table apply to a period of twenty-four hours, beginning at 9 A. M. on the day indicated in the first column. A dash denotes, that the result is included in the next following observation.

REMARKS.

Eighth Month.—23. Morning very clear : mid-day *Cumulus* beneath large *Cirri* : p. m. inosculation, followed by a shower to the NW, which sent us a turfy odour with the wind. 24. *Cirrostratus*, followed by *Cumulostratus*, at times heavy ; the wind veered to SW, p. m. 25. Large *Cirri*, directed from SW to NE. 26. *Cumulostratus* and *Cumulus* crossed by *Cirrostratus*. 27. The hygrometer advanced to 67° : gentle rain, a. m. : cloudy, p. m. 28. *Cumulus* and *Cumulostratus* : a little rain, evening. 29. *Cirrocumulus*, beautifully coloured at sun-set, in lake shaded with violet. 30. Some very light rain, a. m : fair, with fresh breeze after it. 31. Large *plumose Cirri*.

Ninth Month.—1. Lowest temperature on the ground 44°. This morning from two to three it thundered and lightened much to the SE: thunder clouds prevailed, a. m.: wind SE, and a little rain: a slight shower again at night, and much dew after it: the hygrometer advanced to 80°. 2. After large *Cirri*, *Cumulostratus*, which inosculated about sun-set with a scanty *Cirrocumulus*. 3. A mixed sky, with a slight driving shower at evening: cloudy night. 4. A sweeping rain, early: hygrometer, 80° at six, a. m.: much hollow southerly wind: *Cirrocumulus*, followed by ill-defined *Cirrus* with *Cumulus*; and about five, p. m. a *Nimbus*, shaped like a low, circular hay-rick, with a capped *Cumulus* by its side, on the NE horizon. 5. Much rain, for the most part small and thick. 6. Wet, cloudy morning: very turbid sky: hygrometer at 80°: calm air: in the evening, inosculation of *Cumulus* with *Cirrocumulus*; after which frequent lightning between nine and ten, p. m. 7. Morning gray, with *Cirrocumulus*: sun-shine followed, with inosculation of *Cumulus* and *Cirrostratus*. 8. Large *Cirri*, with fleecy *Cumuli*: the latter attached themselves in their passage to the smoke of the city, and appeared to disperse downwards into it. Thunder clouds followed this appearance, and a smart storm passed in the S, from W to E, about five, p. m.: the crown of the nearest *Nimbus* reached our zenith, and we had a few drops; while it rained hard, with a bow in the cloud, within two miles of us. 9. Heavy *Cumulostratus*: and showers, p. m. 10. Fine breeze, with *Cumulus* and *Cirrus*; the latter survived the sun-set, and was kindled with flame colour passing to red: calm at night, with hygrometer 45°. 11, 12, 13. Chiefly *Cumulus*, and *Cumulostratus* by inosculation: some fine grouping of the clouds at intervals: large *Cirri* at the conclusion. 14. A large meteor seen passing northward: windy night. 15. Cloudy, windy: hygrometer, 75°: wet, p. m. 16. Much dew: a rapid propagation of *Cirrus* from the S, followed by *Cumulostratus* and showers: during a heavy shower about nine, p. m. it thundered in the N W: the barometer stationary great part of these two days at 29·60 inches. 17—20. Windy at intervals, with *Cirrostratus*, turbidness, and driving rains. 21. Much wind, with showers: the sky turbid, and streaked with *Cirrostratus*, in a direction from SE towards NW: calm night.

RESULTS.

Wind for the most part Westerly, and moderate.

Barometer:	Greatest height	30·30 inches.
	Least	29·32
	Mean of the period	29·860
Thermometer:	Greatest height	80°
	Least	39
	Mean of the period	58·68
Mean of the Hygrometer		54
Evaporation		2·33 inches.
Rain		1·71 inches.

The rains of this period, though absorbed by the parched ground as by a sponge, have completely restored vegetation in our meadows, which have resumed, in the space of a few days, a verdure equal to that of spring. Neither the natural nor the artificial indications of this change of weather were very striking: the most considerable being, probably, the sudden increase of temperature in the *nights* previous to the more considerable falls of rain.

Tottenham, *Ninth Month*, 22, 1818. L. HOWARD.

Large Meteor.—On the 14th of the ninth month (Sept.) about half-past 10, p. m. a meteor was observed, in a direction nearly due north from Tottenham, which must have been a very conspicuous object to the inhabitants of more northern countries. When first observed, it was but moderately elevated above the horizon on which it appeared to descend slowly, continuing in sight for some minutes. My informant judged its apparent diameter to be at first equal to that of the moon when at her greater elevation: it had a diverging train, which was compared to a brush: the colour white, changing to red as the body descended and decreased in diameter; at which time a second observer reports that it simply emitted sparks. The course of this meteor was probably directly northward from the eye, which may account for its apparently slow motion. Further observations from those who *may have seen* it more to the north will be acceptable. I am not enabled to give *the particulars* with greater precision than as above.

ANNALS

OF

PHILOSOPHY.

NOVEMBER, 1818.

Article I.

Biographical Account of Sir Torbern Bergman, Professor of Chemistry in Upsala. By Thomas Thomson, M.D. F R.S.

I AM induced to draw up the following account of Bergman because I consider the events of his life, spent as it was in the tranquillity of the University of Upsala, as furnishing an admirable lesson to the young chemist of the result of unremitting industry when united with a good education and excellent abilities, and its ultimate tendency to overcome all the obstacles thrown in the way of its possessor by the jealous rivalship of contemporaries, or the malignant obstructions of those who already occupy the stations to which a poor man of genius naturally looks forward. My knowledge of the biographical facts is derived partly from the oration of Hjelm, delivered in the Royal Academy of Sciences at Stockholm, on May 3, 1786; and partly from the eloge of Bergman drawn up by Condorcet, and printed in the Memoirs of the French Academy.

Torbern Olof Bergman was born on March 9, 1735, at Catherinberg, in West Gothland. His father, Barthold Bergman, was a revenue officer in the district of Wadsbo, and the province of Skaraborg. His mother, Sarah Hägg, was a merchant's daughter in Gothenburg, who had been previously married to another revenue officer. Torbern Bergman was the eldest child of this second marriage; and his mother bore afterwards two other children, a son and a daughter.

The first part of Bergman's education was conducted at home. In the harvest of 1746 he went to the school of Skara. There he remained for six years, studying with great zeal and much

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and left him only to choose
This restraint almost proved fatal.
It was found necessary for him to
and return home. His relations, finding it
with his inclinations, at last indulged them,
to pursue those studies of which he was

at Upsala, Bergman devoted himself with
unremitted attention to the study of mathematics,
natural philosophy. He was in the habit of getting up at
morning, and of going to bed at eleven. The books
he studied in the first place were Wolfe's Logic, Walle-
system, Euclid's Elements, Keil's Physics and Astronomy.
These two works were then reckoned the best introduction
mechanical philosophy.

At that time, Linnæus, after having surmounted obstacles
sufficient to have crushed a man of ordinary energy, was in the
height of his glory, and was revered every where as the
patriarch of natural history. He had infused the enthusiasm
which actuated his own breast into the minds of his pupils, and
at Upsala every student was a natural historian. Bergman, in
particular, attached himself to Linnæus, and bestowed much
pains on botany and entomology. This last branch of natural
history indeed is deeply indebted to him. He first displayed in
those powers of arrangement which constitute the charm of
his works, and that penetration which produced afterwards such
important fruits.

This friend was Jonas Victorin, his cousin, at that time *Magister Docens* in the University of Upsala.

He examined the different species of hirudines, or leeches, which are natives of Sweden. While engaged in this examination, he made a discovery which I shall endeavour to explain. The females of the genus of insects, called by Linnæus *coccus*, adhere to the plants on which they feed so immoveably that they have the appearance of *galls* rather than animals. Linnæus, in the Fauna Suecica, No. 2080, described an animalcule which he was disposed to consider as a female coccus; but as no one had seen it, except adhering to aqueous plants, the Swedish Pliny was unwilling to decide whether it was really a coccus or the ovum of some aquatic animalcule. Bergman instituted a set of observations on this substance, and soon ascertained it to be the ovum of the hirudo octoculata. Linnæus was at first unwilling to credit the truth of this discovery; but when Bergman had convinced him of the accuracy of his observations by ocular demonstration, Linnæus sent the account of them, as drawn up by his pupil, to the Stockholm Academy, with a very flattering panegyric. *Vidi et obstupui.*

Bergman speedily distinguished himself by numerous papers on different branches of natural philosophy. He passed rapidly through all the gradations of rank usually conferred on students at Upsala, and in 1761 was appointed Magister Docens in physics. During the six years which he filled this situation he still further distinguished himself by a great number of ingenious papers; for example, on the aurora borealis, on the rainbow, on the twilight, &c.

In the year 1767, Johann Gottschalk Wallerius, who had long been Professor of Chemistry at Upsala, and possessed a very high reputation, resigned his chair. Bergman was at that time by far the most distinguished young man at the University of Upsala, and had not neglected his chemical more than his mathematical studies. His dissertation on the manufacture of alum, published on April 1, 1767, and his treatise on physical geography, which had made its appearance a year earlier, afford specimens of a minute knowledge both of chemistry and mineralogy, such as could scarcely have been looked for from a person who had not hitherto devoted himself exclusively to chemical pursuits. He accordingly offered himself a candidate for the vacant chair; and his dissertation on the manufacture of alum seems to have been composed chiefly to show his acquaintance with the science which he aspired to teach.

But Wallerius had other plans. There was a relation of his own whom he wished to succeed him; and such was the influence of that celebrated Professor, that there was every probability of his accomplishing his object. It is asserted by Condorcet, that he attacked Bergman's dissertation on the manufacture of alum in a style of acrimony which did him but little credit.

Gustavus IV. afterwards so distinguished when King of

Sweden, was at that time Crown Prince and Chancellor of the University of Upsala. The character and abilities of this extraordinary man are well known. He entered with his usual zeal into the dispute respecting the chemical chair, and consulted Von Swab and Tilas upon the merits of the candidates. Neither of these eminent men was personally acquainted with Bergman; but they were not ignorant of his writings nor of the high character which he bore at Upsala for industry and talents. Von Swab's opinion of Bergman's chemical skill was founded upon the dissertation on the manufacture of alum, while Tilas came to a similar conclusion from the second part of the physical geography which Bergman had written. Fortunately for chemistry and for the reputation of Sweden, both of them strenuously recommended Bergman as the candidate who ought to get the professorship. Gustavus, in consequence, took the part of our young philosopher; and he was so keen on the subject, that he supported his cause in person before the senate. Wallerius and his party were of course baffled, and Bergman got the chair.

His previous education and habits fitted him peculiarly for the cultivation of that science to which he was to dedicate the remainder of his life. At that time the intimate connexion between physics and chemistry, which is now so close that the exact boundaries of the two sciences cannot be defined, was not quite so visible. The mode of reasoning was not exactly similar to that which was followed by those who cultivated mechanical philosophy; certain occult causes and unknown bodies were admitted without hesitation, and were supposed to play a very conspicuous part among chemical phenomena. It is sufficiently obvious that a man familiarly acquainted with the principles of mathematics, accustomed to mathematical reasoning, capable of applying it to the different branches of mechanical philosophy, skilled in the phenomena and laws of electricity, optics, hydrostatics, and pneumatics, and possessed of those general views which are the natural result of a complete education—it is sufficiently obvious that such a man must possess prodigious advantages in studying chemistry over the uninformed and contracted mind of the mere chemist. Even at present when the science of chemistry has made considerable progress, when its principles are in some measure established, and the mode of investigating its phenomena ascertained, it is easy, at a single glance, to perceive the superiority of those who have imbued the principles of mathematics and physics over those who have been so unlucky as not to have received a sufficiently liberal education. When Bergman began his chemical career, these advantages must have been of still greater importance than they are at present, because the principles of the science were still to be investigated, and many prejudices and false opinions, originating from ignorance and contracted views, still retained their full force. Accordingly, it is the extent of the views, the soundness of the reasoning, and the excellence of the arrangement, which constitute the merit of Bergman's writings. His powers of invention do not seem to have been great; he scarcely ever attempted to investigate unknown substances, nor do we owe to him the discovery of a single new simple body, or gas; while Scheele, though his situation was apparently much less favourable for such investigations, brought to light a vast number of new bodies, and made a greater addition to chemical substances than any chemist that either preceded or followed him. But Bergman appears to have been more fully aware of the extent of his science than any of his contemporaries. He had experimented on all the chemical bodies that were known in his time. His dissertations are more complete than any contemporary ones. He first laid down the rules for the application of chemistry to minerals and waters. His essay on elective attractions, though much of it was theoretical, displays the extent of his views in a very conspicuous manner. It must have contributed very materially to the future progress of the science by pointing out to chemists the facts already known, and the vast number of blanks which required to be filled up before chemistry could be considered as approaching to perfection. Though his views respecting affinity were not all sound, and though he reduced its laws to a degree of simplicity which the phenomena do not warrant, yet this does not appear to have been injurious to the advancement of knowledge, because new facts were to be acquired only by experiment; and this was the mode of investigation universally adopted. Berthollet, who pointed out the weak parts of the Bergmanian views respecting affinity, has himself advanced a new theory, which he has supported with infinite ingenuity and sagacity. No chemist ever possessed a greater stock of genius; and he draws upon it in his endeavours to support this theory in the most lavish manner. But Berthollet's theory, notwithstanding the abilities of its inventor and the admirable way in which he has contrived to support it and to palliate its defects, is still less conformable to the phenomena than Bergman's; for if carried to its full extent, it would destroy the existence of definite compounds altogether; that is, it would destroy the very existence of the science which it was brought forward to improve; for if there were no definite compounds, there could be no such science as chemistry at all. The fact seems to be, that the investigation of the ultimate laws of affinity (if the expression be allowable) is beyond our reach, at least in the present state of the science. If we ever are to arrive at any precise facts respecting these laws, it must be by an indirect road; and, indeed, the atomic theory seems likely to throw some light on the subject. But that theory must be much further advanced than at present, before we can have it in our power to draw any important consequences from it respecting the laws of affinity.

Bergman filled the chemical chair at Upsala for 17 years, and during that period his numerous publications entirely altered the appearance of the science. He introduced an order, a perspicuity, an exactness, which were unknown before, and which were certainly one of the great causes of the subsequent rapid progress of chemistry. Their influence was universally felt; and as long as Bergman lived, he was universally looked up to as one of the patriarchs of the science.

To satisfy our readers of the high reputation which Bergman acquired, we may mention the attempt of the great Frederick of Prussia, in 1776, to prevail upon him to become a member of the Prussian Academy of Sciences, and to settle at Berlin. Bergman took some time to consider the offer of his Prussian Majesty, which was highly honourable, and advantageous even in a pecuniary point of view; but the King of Sweden, who was justly proud of his illustrious subject, would not permit him to transfer his allegiance, announcing, that he would consider his expatriating himself as a personal offence to his Majesty. As some compensation for this sacrifice, Bergman received the honour of knighthood, and a pension of 150 rix dollars was annually paid him out of the Royal treasury.

Nor is it a less striking proof of the estimation in which he was held in foreign countries that the Royal Academy of Sciences of Paris, on the death of Sir John Pringle, elected him one of the eight foreign associates to which their number was restricted. He had been a Fellow of the Royal Society from the year 1764. This honour is never conferred except upon the most distinguished foreigners. Though as the number of such Fellows is not limited, as was the case with the French Academy, the same kind of difficulty does not present itself to prevent the conferring of such an honour upon such individuals as are considered to be deserving of it.

But it was not his publications alone which constituted his merit. His lectures were no less valuable; and the pupils whom he educated contributed, in no small degree, to spread his reputation. Gahn, Hjelm, Gadolin, the Elhuyarts, and others, who afterwards acquired celebrity, were educated by him. His first care after obtaining the chair was to collect all the different chemical substances and their products, and to form them into a cabinet. Another cabinet contained the minerals of Sweden, arranged according to the places where they originated; and a third consisted of models of the different instruments employed in chemistry and in chemical manufactures. These were designed for the instruction of his pupils, whom he encouraged and inspired with that confidence and enthusiasm which is requisite for the successful prosecution of practical chemistry.

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Gustavus IV. afterwards so distinguished when King of deal of the value of his papers would depend. John Afzelius, his nephew, who afterwards succeeded him, was for some years his assistant, and must of course have performed most of his experiments during that time. Afzelius was considered as an accurate experimentalist, his reputation was high, and he succeeded his uncle without opposition. But I am not acquainted with any thing which he has published since Bergman's death, except a single paper on the analysis of sulphate of barytes.

Bergman's health for some years previous to his death had become delicate. He was afflicted with the hæmorrhoids, and threatened with an hæmoptysis. His immediate death seems to have been occasioned by violent hæmorrhoidal discharge which brought on general convulsions, accompanied with the total loss of understanding. This continued for ten days, at the end of which he sunk altogether. He died on July 8, 1784, at the mineral wells of Medevi on the Lake Wetter, to which he had repaired in consequence of the badness of his health.

His death was followed by the most unfeigned sorrow, not only of those who were at that time at Medevi, but of the whole inhabitants of Sweden. He was buried at Westra Nykyrke, not far from Medevi; and his funeral was attended by almost the whole population of Medevi, and by a prodigious concourse of people from every part of Sweden. Never was a man of science more respected, nor a professor more lamented, than Bergman. Scheele followed his friend in two years; and Sweden, from being one of the first chemical countries in Europe, sunk at once, as far as that science is concerned, into comparative insignificance and absolute torpor. At present, indeed, in consequence of the unequalled activity, and zeal, and skill of Professor Berzelius, that kingdom has resumed her rank among chemical nations; but a listlessness of nearly 20 years elapsed before this activity began.

Bergman's papers amount altogether to 106. They were published between the year 1755, in which his inaugural dissertation "De Crepusculis" appeared, and the year 1784; for his little paper entitled "Mineral Observations" was published only a few weeks before his death. The greater number of them were collected in six octavo volumes entitled "Torberni Bergman Opuscula Physica et Chemica." The first three volumes of this collection were published by Bergman himself in the years 1779, 1780, and 1783. The fourth volume was published at Leipsic in 1787, and was edited by Dr. Ernest Benjamin Gottl. Hebenstreit. The fifth volume was published by the same editor in 1788; and the sixth and last volume, which contains some of the most early papers of our author, did not make its appearance till the year 1790. In the observations which I mean to make on these productions of Bergman, I shall pass over his essays on natural history and physics, and confine myself to his chemical papers, on which his reputation in a great measure depends. These, if we omit the Physical Geography, the Notes on Scheffer, the Sciagraphia, and the History of Chemistry, amount to about 48. It will be most satisfactory, perhaps, to take them in the order in which they occur in the Opuscula, as this was the order which Bergman himself gave them. The first two volumes of the Opuscula, and part of the third, were translated into English by Dr. Edmund Cullen and Dr. Beddoes, and the fourth volume by Mr. Heron. I am sorry to observe that Mr. Heron's translation is far from accurate. He often mistakes the meaning of his author, and does not appear to have been sufficiently acquainted with the science of chemistry to understand Bergman's Latin; which, though sufficiently perspicuous to one acquainted with the subject discussed, is not, perhaps, always classical.

1. He prefaces his Opuscula with a short dissertation on the Investigation of Truth, in which he gives us the rules which he himself always followed in his investigations. These rules are chiefly curious by showing us the state of chemistry when Bergman began his career. It is now universally admitted that the only mode of advancing chemistry is *experiment*. Experiments are now made with so much care that there is very seldom any dispute about *facts*. The discussions which exist at present in the science relate entirely to the consequences deduced from these facts. The most striking discussion of the kind in modern chemistry is the question whether *chlorine* be a *simple* or a *compound* body; or rather, whether it contains *oxygen* or not. Almost all the British chemists, all the French chemists, and most of the German chemists, conceive it to contain *no oxygen*; while Berzelius, and one or two individuals in Scotland, consider chlorine to be a compound of *oxygen* and an *unknown basis*, according to the original theory of Berthollet and the French chemists. If Bergman's old maxim were to be adopted universally, this dispute would be cut short for the present. This maxim was to consider every body as *simple* till some evidence be produced that it is a *compound*, and not to admit the existence of a principle in a body till it can be shown experimentally to exist in it. The experiments of Gay-Lussac, Davy, &c. to decompose chlorine, though varied in every conceivable way, are admitted on all hands to have been unsuccessful. We have, therefore, no evidence at present that it is a compound. Neither has the existence of oxygen in it been demonstrated by experiments upon which any stress could be laid. The only argument which Berzelius has brought forward is founded on a law of his own invention. Yet he admits that this law does not hold in the case of the nitrates and phosphates. If we suppose it not to hold in the muriates, what becomes of his argument? This supposed law of Berzelius can be shown to be only a particular case of the atomic theory. We can by means of that

theory explain all the cases which are conformable to his law, and those likewise which do not agree with it; and we can explain the composition of the muriates just as easily on the hypothesis that chlorine is simple as that it is compound. Chlorine, indeed, for any thing we know to the contrary, may be a compound, and may contain oxygen as one of its constituents; so may azote, and so may iron. But our opinions respecting the composition of bodies must be conformable to the evidence which is laid before us; otherwise we forsake the road of science, and get into that of fancy and romance.

The rules for investigating chemical phenomena are sufficiently simple, and may be reduced to the following.

(1.) Every fact must be established by satisfactory experiments.

(2.) A body must be considered as *simple* unless satisfactory evidence can be brought to show that it is a compound.

(3.) The most satisfactory way of showing a body to be a compound is to separate its constituents, exhibit them in a separate state, and to show that by uniting them again together, the original compound body is produced.

(4.) When a substance cannot be exhibited in a separate state, it is always hazardous to draw any peremptory conclusions respecting its existence. Our conclusions should be given only as hypothetical or conjectural; because the only unequivocal evidence of the existence of a chemical body is wanting. The existence of the principle called *phlogiston,* so universally admitted at one period, is an example in point, which should make us cautious in our conclusions.

2. *On Carbonic Acid.*—Bergman seems to have been the first who considered this substance as an acid. His opinions on the subject were communicated to foreign chemists in 1770, and his first essay on this acid made its appearance in 1773. It would be needless, considering the present state of our knowledge, to give a minute account of this essay, though at the time of its publication it must have been exceedingly valuable. He describes the mode of procuring this gas, shows that it possesses the properties of an acid; that water at the temperature of 41° absorbs rather more than its bulk of it; that the specific gravity of such water is 1·0015; that the specific gravity of carbonic acid gas is rather more than 1·5, and that it combines with the different bases, and forms salts. He prepared and described bicarbonates of potash and soda, carbonate of ammonia, carbonate of barytes, carbonates of magnesia, zinc, and manganese. He determined the order of the affinities of carbonic acid for the bases; and he showed that it is the weakest of all the acids known when he wrote.

3. *Of the Analysis of Waters.*—This paper, first published in 1778, was of great importance at the time of its appearance. In it the method of analyzing waters is first laid down. Before the

appearance of this treatise, the method of analysing waters may be considered as unknown. Several attempts, indeed, had been made with more or less success; but no general formula applicable to waters in general had been thought of. Considerable improvements have been recently made on the method of analyzing mineral waters. This, indeed, was the natural consequence of our more accurate knowledge of the exact composition of the different salts which exist in mineral waters, and of the simplest methods of detecting them and estimating their quantity. Kirwan published a treatise on the same subject about the beginning of the present century. But his methods are rather too complicated for actual practice, and they seem scarcely compatible with much precision. Dr. Murray's formula, published in the eighth volume of the Transactions of the Royal Society of Edinburgh, is, as far as it goes, the best and easiest method of analyzing mineral waters. It seems unnecessary in the present state of our knowledge to enter into any particulars respecting Bergman's paper. For the same reason we may omit his papers on the Waters of Upsala, on the Acidulous Spring in the Parish of Denmark, on Sea Water, on the Artificial Preparation of Cold Medicated Waters, and on the Artificial Preparation of Hot Medical Waters. These papers were of much utility at the time of their publication; but at present the science has made such progress, that they have lost a great deal of their interest.

4. *On the Acid of Sugar.*—This paper was originally written as an inaugural dissertation, which was defended in 1776 by J. A. Arvidson. Hence, doubtless, the reason why nothing was said about the discovery of oxalic acid, and why it was generally supposed at first by the chemical world that Bergman himself was the discoverer of that acid. It is now known that the acid in question was discovered by Scheele; who merely communicated the process to Bergman. In this paper Bergman describes the method of preparing oxalic acid, the properties by which it is characterized, and the salts which it forms with 22 bases, all that were known to exist at the period when this dissertation appeared.

5. *On the Preparation of Alum.*—This dissertation, which has been mentioned repeatedly in the preceding biographical account, contains a history of alum, a chemical examination of its composition, a description of its ores, a minute description of the processes followed by manufacturers, and a set of experiments undertaken with a view to improve these processes. Even at present this dissertation will be allowed to be excellent, and alum makers would probably derive useful hints from a careful perusal of it. He was aware of the importance of potash and ammonia, and owns that the facts would lead to the conclusion that alum is a triple salt. But he rejects this supposition on account of the fact that ammonia is equally efficacious in pro-

moting the crystallization of alum with potash. Soda and lime he found possessed no efficacy whatever. It is rather surprising that this did not lead him to the true conclusion, that there are two species of alum, one containing potash, and the other ammonia. This conclusion was first drawn by Vauquelin. Whether the analysis of alum by Berzelius, which is commonly received, be correct, is a point that I rather believe will require some further examination. The subject is of importance, because the weight of an atom of alumina, and even the mode of manufacturing alum, must be a good deal influenced by it.

6. *On Antimoniated Tartar.*—This is the name by which Bergman distinguished tartar emetic, the only antimonial preparation much used in medicine. This dissertation is of considerable importance. He details the different processes given for preparing this salt, and shows that they were so discordant and inaccurate, that the same substance could not be obtained at different times. His process is to mix powder of algaroth (the white powder which precipitates when chloride of antimony is mixed with water) with cream of tartar, to boil the mixture for half an hour in water, then to pour off the liquid, evaporate to a pellicle, and crystallize. It is now known that tartar emetic is a salt composed of bitartrate of potash (which acts the part of an acid) and protoxide of antimony.

7. *On Magnesia.*—This dissertation, first published in 1775, may be considered as the third chemical dissertation on magnesia. The first was by Dr. Black, in 1755; and the second, by Margraf, in 1759. Bergman describes the method of obtaining magnesia, details its properties, and gives a pretty full account of the salts which it forms with the different acids. The only paper of much consequence which has made its appearance upon magnesia since Bergman's paper, is a small book published by Butini, of Geneva, in 1781, entitled "Nouvelles Observations et Recherches Analytiques sur la Magnesie du Sal d'Epsom." But most of the magnesian salts have been analyzed with tolerable accuracy by modern chemists.

8. *On the Forms of Crystals.*—This paper was first published in 1773, and is remarkable, because it contains the very same discovery which afterwards led Haüy to his theory of crystals. He shows that the primitive form of calcareous spar is a rhomboid, the faces of which have angles of 101½° and 78½°, that all the different crystals of calcareous spar may be formed upon such a base, and that a nucleus having the primitive form may be extricated mechanically from all the different forms. In short, this curious paper, which he informs us was the fruit of many years' assiduous observations on crystals, may be considered as exhibiting the first outline of Haüy's theory.

9. *On Siliceous Earth.*—This paper was published in 1779. *Bergman* in it states with precision the chemical characters of *silica*, shows that it differs in its properties from the other earths,

that it cannot be converted into them, and, therefore, that it is entitled to be considered as a peculiar substance. He adopts Scheele's notion, that silica is a compound of fluoric acid and water; an opinion soon after refuted.

10. *On the Hydrophanous Stone.*—This name was given by Sir John Hill to certain stones which are opaque in the air, but become transparent when plunged into water. They were sold at an extravagant price. But the secret of these stones is here revealed by Bergman. Various minerals, particularly opals and chalcedony, exhibit this property. Such stones have hollow cavities in them. When these cavities are filled with air, the stone is opaque, in consequence of the very different refracting power of the stone and the air. But when the cavities are filled with water, the stone becomes transparent, because the refracting power of water approaches more nearly that of the stone itself.

11. *On the Earth of Gems.*—This elaborate paper was first published in 1777, and is not the least remarkable of Bergman's labours. It contains the first attempt to give an accurate analysis of the very hard stony bodies. The processes, though rude, exhibit obviously the rudiments of our present processes. Indeed Bergman must be considered as the original author of the processes for analyzing mineral bodies by the moist way. It would be useless to enter into details respecting his results, as it is not surprising that they should be all inaccurate. Indeed as he gives a very imperfect account of the bodies to which he affixes particular names, it is not always easy to conjecture what the mineral really was that he subjected to analysis. Professor Jameson, for example, conjectures that the *hyacinth* of Bergman was in reality a cinnamon stone. But I had an opportunity of seeing the very collections of hyacinths from which Bergman's specimens for analysis were selected; for they are still in the University of Upsala, in possession of Professor Afzelius; and there cannot be the least doubt entertained that they are true hyacinths.

The next dissertation on the earth of the tourmaline stone needs not be particularly noticed, as the analysis was conducted precisely in the same way as the analyses of the gems.

12. *On the Fulminating Calx of Gold.*—This paper, first published in 1769, contains the first accurate account of the properties of fulminating gold, the first attempt to ascertain its composition experimentally, and to explain its fulminating power. According to Bergman, fulminating gold is a compound of oxide of gold and ammonia. Ammonia is a compound of azote and phlogiston. When heat is applied, the phlogiston reduces the gold; and the azote being suddenly disengaged in its elastic state, occasions the explosion. The theory of this remarkable powder has advanced but little since Bergman's time. Analogy would lead to the suspicion that it is a compound of gold and

bte, or of oxide of gold and azote. But we have no proof tt this is really its composition.

13. *On Platina.*—This dissertation was published in 1777, and is chiefly valuable as explaining the effects of the alkalies when dropped into a solution of platinum. It was Bergman that first showed that sal-ammoniac precipitates platinum by forming with it a triple salt which is but little soluble in water. Potash produces a similar effect; but soda and lime do not form triple salts, but precipitate, according to him, the metal in the state of an oxide.

14. *On the White Ores of Iron.*—This paper, first published in 1774, contains the first account of the properties of the metal called *manganese.* These properties were partly detected by Bergman, partly by Scheele, and partly by Gahn. It was Gahn that first obtained manganese in the metallic state. It would be needless to give the substance of this elaborate and valuable paper; because we are now possessed of more accurate means of analysis; and the properties of manganese are known with greater precision than they were when Bergman wrote.. Bergman's method of separating iron and manganese from each other by solution in nitric acid and calcination was used till Vauquelin substituted another, which, however, does not succeed better.

15. *On Nickel.*—This paper was published in 1775, It contains an elaborate set of experiments to obtain nickel in a state of purity. These experiments were all made in the dry way; and were not perfectly successful. But our author succeeded in establishing the peculiar nature of this metal by showing that its properties became more and more peculiar the more completely it is freed from foreign bodies.

16. *On Arsenic.*—This paper, originally published in 1777, contains the fullest and best account of the properties of arsenic which has yet appeared. It contains, indeed, certain mistakes and erroneous deductions, which flowed unavoidably from the state of the science in 1777. Except the correction of these mistakes, and more exact numeral results, the chemical knowledge of arsenic has advanced but little since the days of Bergman.

17. *On the Ores of Zinc.*—This dissertation was published in 1779, and contains an analytical examination of all the ores of zinc which were then known. He succeeded in pointing out the constituents of all these ores with sufficient accuracy; though his methods were not sufficiently precise to enable him to obtain the accurate proportions of each.

18. *On Metallic Precipitates.*—This paper, first published in 1780, is one of the most elaborate productions which Bergman has left us. It may be considered as the first attempt to investigate the nature of the metallic oxides, and to point out the state in which the different metals are precipitated by various

reagents. Though it contains a great deal of erroneous theory, yet, as the experiments are all distinctly and numerically stated, we have it in our power to strip them of the theory in which they are involved, and to apply them to the present state of our knowledge. They must have contributed very materially to guide the subsequent investigations of chemists; though the numbers given by Bergman are not sufficiently precise to enable us, from them alone, to deduce the composition of the metallic oxides.

19. *On the Art of assaying in the humid Way.*—This dissertation appeared likewise in 1780, and is no less than a complete treatise, explaining the method of analyzing the ores of all the known metals. It was the first treatise of the kind that appeared, and constituted the groundwork of all that has since been done. It would be useless to examine it here. Almost every part of the treatise has been improved upon; almost every formula has been modified or altered. But it must be at once obvious how much the art of analysis owes to Bergman for this commencement.

20. *On the Blow-pipe.*—This paper had been sent in manuscript to Baron Born in 1777, by whom it was published in 1779. It contains directions how to make experiments with the blow-pipe, and gives a very particular account of the phenomena exhibited by the different stones, metals, and ores, when heated by the blow-pipe, either alone, or mixed with the different fluxes. Since that time, the use of the blow-pipe has been still further improved by Assessor Gahn. His essay on the subject, published in a preceding volume of the *Annals of Philosophy*, we recommend to the careful study of every person who wishes to become expert in the use of this very important instrument of investigation.

21. *On the Analysis of Iron.*—This important dissertation, published in 1781, contains the experiments, by means of which the difference between iron, cast iron, and steel, was accounted for. Bergman first detected the presence of plumbago in cast iron and steel, and he first showed that iron yields more hydrogen gas than either cast iron or steel. The experiments were very numerous; and as far as they went, they are sufficiently satisfactory.

22. *On the Cause of the Brittleness of Cold Short Iron.*—This paper, like the last, was published in 1781. When cold short iron is dissolved in sulphuric acid, a white powder remains, which, when heated with charcoal, was reduced to a metallic button. To this substance Bergman gave the name of siderum; and he showed that when added to iron it renders it cold short. It was soon after shown, that this supposed new metal is merely a phosphuret of iron. Hence it has been inferred, that iron is rendered cold short by uniting with phosphorus.

This paper has been already carried to such a length, that it be possible to give nothing more than the titles of the maining dissertations of Bergman, with the date of the publication of each.

23. On the different Quantity of Phlogiston in Metals. 1783.
24. On Sulphuret of Tin. 1781.
25. On the Sulphurets of Antimony. 1782.
26. On the Products of Volcanoes. 1777.
27. On Elective Attractions. 1775.
28. On the Analysis of Lithomarga. 1782.
29. On Asbestus. 1782.
30. Thoughts on a Natural System of Minerals. 1784.
31. On the Combination of Mercury and Muriatic Acid. 1769.
32. On the proper Mode of burning Bricks. 1771.
33. On the Acidulous Waters of Medevi. 1782.
34. On the Medicinal Springs of Lokarne. 1783.
35. On Cobalt, Nickel, Platina, and Manganese; and on the Nature of their Precipitates. 1780.
36. Chemical Analysis of Indigo. 1776.
37. On Vegetable Soils. 1771.
38. On the Mountains of Westgothland. 1768.
39. On the latest Chemical Discoveries. 1777.
40. Mineralogical Observations. 1784.

ARTICLE II.

On the State in which Potash exists in Vegetables, and on the Saccharine Matter of the Potatoe. By Dr. Peschier.

(To Dr. Thomson.)

SIR, *Edinburgh, Aug.* 12, 1818.

THE enclosed was sent me by Lord March, that it might be transmitted to you; the author being desirous that, if approved of, the discovery contained in it might have a place in your journal.

I am, Sir, with esteem,
Your obedient servant,
JOHN PLAYFAIR.

(To Lord March.)

MY LORD, *Geneva, July* 20, 1818.

You are too great a friend of the sciences, and I take too much pleasure in communicating to you the discoveries which may originate in this city, to allow you to remain ignorant of some new facts ascertained in the laboratory of my brother, and which will soon be communicated to the public.

The chemical analysis of vegetables having been for some years a favourite pursuit of the chemists, different vegetable principles have been discovered in different parts of plants; but hitherto it has not been demonstrated in *what state potash occurs in vegetables;* and though it has been found in the ashes of plants, its presence had not been ascertained either in their expressed juices or their decoctions. A set of experiments made upon a certain genus of plants with a view of studying its medical virtues has led to the discovery of potash in these different liquids, and has suggested an easy mode of determining the acid with which the potash was united.

All the juices (the word *juice* denotes the liquid expressed from a plant, but not from its fruit), or the decoctions of the different parts of a vegetable, are more or less acid, reddening paper stained blue with litmus, &c. It was necessary to find a substance which should not only combine with the disengaged acid, but which should have a greater affinity for that acid than potash itself has. The acids which occur most commonly in plants being the carbonic, the tartaric, and the oxalic, it was necessary besides that this substance should form an insoluble salt with each of these acids. *Pure magnesia* answers this purpose completely. If then we agitate in the cold, or boil together a vegetable juice or decoction, and a quantity of pure magnesia, we obtain, after the separation of the deposite, an alkaline liquid, which possesses all the characters of a solution of carbonate of potash. By examining the magnesia in the requisite manner, we can easily determine the acid with which it has combined. (The tartrates and oxalates of magnesia are insoluble, when there is no excess of acid—an excess which it is of importance to avoid.)

The insolubility of pure magnesia and of a part of the salts which it forms when united with acids, renders the process very accurate, and of very easy execution.

If the salts contained in the vegetables be sulphates or nitrates, they not only do not redden vegetable blues (because there is no excess of acid present); but magnesia is not capable of decomposing them. This is the case with borage, &c.

This discovery, besides its importance in the analysis of plants, facilitates the means of judging of the quantity of potash contained in vegetable juices. Hereafter, incineration will not be necessary in order to obtain that potash. The choice which a philosophical society in Holland made of this problem as a prize question (in 1817), proves the interest with which it was viewed.

Second Discovery.—In consequence of a careful analysis, Vauquelin drew as a conclusion, that potatoes are composed of starch, of parenchyma, of a peculiar animal matter, and of certain salts. These different substances did not explain the cause of the spirituous fermentation which they undergo, if they are exposed, sufficiently diluted with water, and mixed with a little barley meal to the requisite temperature. Hence it has been proposed as a prize question, to discover the substance which in potatoes supplies the place of sugar, to which alone the spirituous fermentation is conceived to belong. A set of experiments on potatoe meal, obtained by rasping, washing, drying, and grinding, has shown that these bulbs contain sugar and gum in the proportion of 64 gr. of mucous sugar, and of 220 gr. of gum, in the pound weight of potatoe. These two principles were discovered by digesting potatoe meal in six or eight parts of cold water for 24 hours in a cool place, evaporating the water to dryness, and treating the residual mass successively with alcohol and water. Now it is the existence of these two principles which occasions the commencement of the spirituous fermentation, assisted by the barley meal. Their action upon the starch, and the changes induced in it, account for the quantity of spirit produced.

These two discoveries, my Lord, have a real connexion with political economy; and they interest the sciences, as they constitute incontestible matters of fact. I may have the honour hereafter of transmitting an extract of the memoir which my brother proposes to read at the annual meeting of the Helvetic Natural History Society, on the tribe of corns and their products.

Our means of public education will be considerably improved by the choice which has been made of a very convenient place for experimental lectures on chemistry, physics, astronomy, &c. by the association of about 200 persons connected with the same place, who receive all the scientific journals of the world; and who invite foreigners of every description for the election of new professional chairs, and even of new faculties of science and literature. Our academy will see with pleasure foreigners in its bosom (provided they be distinguished by their knowledge) reading public lectures on the sciences, and thus adding to the scientific resources of Geneva. We are at present purchasing in Paris a great many physical and astronomical instruments, which were wanting for our lectures. Already we have begun to form a cabinet of natural history, mineralogy, &c. The place is very large; and we are receiving from all quarters objects worthy of a place in this interesting museum.

PESCHIER, D.M.

ARTICLE III.

Some Additional Observations on the Weights of the Atoms of Chemical Bodies. By Thomas Thomson, M.D. F.R.S. Regius Professor of Chemistry in the University of Glasgow.

THOUGH little more than five years have elapsed since I published my first tables of the weights of the atoms of different chemical bodies in the second volume of the *Annals of Philosophy*, the subject has since that time been investigated with so much skill and perseverance by Dr. Wollaston, Professor Berzelius, and several other chemists, that improvements have been made in almost every individual number. I conceive, therefore, that it will be interesting to chemists if I lay before them an epitome of the present state of the subject. This I shall do by giving a new table of the weights of the atoms of different bodies such as they have been established by the most accurate experiments hitherto made. I am far from flattering myself that the numbers which I shall give are all accurate; on the contrary, I have not the least doubt that many of them are still erroneous. But they constitute at least a nearer approximation to the truth than the numbers contained in the first table. It is only by successive, and probably very slow approximations, that we can expect to reach the truth at last. Every new step is something gained; and, therefore, deserving of attention. I am far from being apprehensive of being found fault with by those who understand the nature of chemistry, and the true mode of improving it, for having formerly given numbers for the atoms of bodies founded on the best data which I could procure at the time, and for abandoning these numbers for others furnished by more accurate experiments. We may expect, now that accuracy is the great object of chemical experimenters, that more and more precise results will be obtained as we proceed. Many, of course, of the numbers which I now give will be to be abandoned hereafter, and new numbers substituted, founded on experiments approaching nearer to absolute accuracy. Meantime we must be satisfied with the best facts which the science can furnish. I am even of opinion that it has a very material tendency to advance the science to lay before chemists the present state of our knowledge, and the value of the data upon which our conclusions are founded.

	Weight of an atom.
1 Oxygen	1·000
2 Chlorine	4·500 [*]
3 Iodine	15·625 [†]
4 Hydrogen	0·125 [*]

[*] The weight of an atom of hydrogen is derived from the composition of water. It has been established, that water is

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[*] This number depends upon the specific gravity of chlorine gas. Gay-Lussac and Thenard found it 2·47. I think Dr. Prout's reasons for considering it as 2·5 are satisfactory. Davy has shown that protoxide of chlorine is a compound of two volumes of chlorine and one volume of oxygen. Now if we consider it as a compound of one atom chlorine + one atom oxygen, it is obvious that an atom of chlorine will weigh 4·5.

[†] This is the number obtained by Gay-Lussac from the combination of iodine and zinc, which he found a compound of 100 iodine + 26·52 zinc. Now 26·52 : 100 :: 4·125 : 15·625. I have very slightly modified Gay-Lussac's numbers to make the atom of iodine a multiple of ·125.

	Weight of an atom.
5 Carbon	0·750
6 Boron	0·875 [b]
7 Silicon	1·000 [c]

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formed by the union of two volumes of hydrogen gas and one volume of oxygen gas. I consider it, with Dalton, as a compound of one atom of hydrogen and one atom of oxygen. Hence the weight of an atom of hydrogen will depend upon its specific gravity. Biot and Arrago found the specific gravity of hydrogen gas 0·074; that of air being 1. Now if the specific gravity of oxygen gas be 1·111, and if two volumes of hydrogen gas are equivalent to one atom, it would follow that an atom of hydrogen weighs 0·133. I have been at much pains in endeavouring to determine the specific gravity of hydrogen gas, but never could find it lower than 0·073, which differs but little from the determination of Biot and Arrago. But I do not think that absolutely pure hydrogen gas has ever been weighed. It usually contains traces of phosphorus, iron, zinc, &c. which must materially affect its weight. On that account I think that Dr. Prout's method of determining the specific gravity of this gas from that of ammoniacal gas is more likely to be correct. In ammonia we are sure that the hydrogen is pure. It is likewise twice as dense in ammonia as it is in hydrogen gas. This doubles the chance of precision. When the weight of hydrogen gas is deduced from ammonia, that of oxygen gas is found to be 16 times heavier. Hence the number in the table for the weight of the atom.

[b] The data upon which this number is founded are not quite satisfactory. Common boracic acid, according to Davy's experiments, is composed of acid 57 + 43 water. If it be a compound of one atom acid + two atoms water, the weight of an atom of boracic acid will be 2·998. From the analysis of borate of ammonia by Berzelius, the weight of an atom of the acid is 2·66. The mean of these two is 2·829. From the experiments on the combustion of boron, there is reason to believe that the acid contains at least two atoms of oxygen. If so, it must be a compound of 2 oxygen + 0·829 boron. The number 0·875 was chosen in preference to this number; because it is a multiple of 0·125, which all the atoms seem to be.

[c] Neither are the data for this number to be depended on. Every thing shows us that silica in stony bodies acts the part of an acid. *Table-spar* is a compound of 50 silica + 45 lime; if it be a bisilicate of lime, the weight of an atom of silica will be 2·015, for 45 : 50 :: 3·625 : 4·03. Again, nepheline is a compound of 49 alumina + 46 silica. Suppose it a silicate of alumina, silica will weigh 1·994; for 49 : 46 :: 2·125 : 1·994. Now the mean of these two numbers is 2·0045. Hence we may

		Weight of an atom.
8	Phosphorus	1·500 [d]
9	Azote	1·750 [*]
10	Sulphur	2·000
11	Tellurium	4·000 [e]
12	Arsenic	4·750 [f]

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conceive the weight of an atom of silica to be 2·000. But as it must contain at least one atom of oxygen, it is obvious that an atom of silica must weigh 1.

[d] There can be no doubt that this is the true weight of an atom of phosphorus. Perphosphuretted hydrogen gas has the specific gravity of 0·9022. The bulk of hydrogen gas is not altered by converting it into perphosphuretted hydrogen. Hence it is composed by weight of

Hydrogen	694	or	1
Phosphorus	8328	..	12

I conceive this gas to be a compound of one atom hydrogen and one atom phosphorus; but 1 : 12 :: 0·125 : 1·5. Perphosphuretted hydrogen gas unites with 1 volume, $1\frac{1}{2}$ volume, and 2 volumes of oxygen gas. Now half a volume of the oxygen gas unites to the hydrogen; the remainder combines with the phosphorus; so that one volume of phosphorus unites with half a volume, with 1 volume, and with $1\frac{1}{2}$ volume of oxygen, forming hypophosphorous acid, phosphorous acid, and phosphoric acid. This is the same thing as if we said that one atom of phosphorus unites with one atom, two atoms, and three atoms of oxygen respectively.

[e] I think it probable that oxide of tellurium is a compound of 100 tellurium + 25 oxygen. Berzelius found 100 tellurium + 24·8 oxygen, which comes sufficiently near. Now if this oxide be a compound of one atom metal + one atom oxygen, it is obvious that an atom of tellurium will weigh 4.

[f] Experiments on arsenic seem to be attended with more

[*] This is the number which Dr. Wollaston selected after a careful examination of the experiments hitherto made on the subject. Mr. Phillips has, with his usual acuteness, shown it to tally very nearly indeed with the best experiments of Davy, Gay-Lussac, Dalton, and his own.—(Royal Institution Journal, v. 162.) I am disposed to consider it as correct. The only experiment which induces me to hesitate is one by Berthollet. He decomposed nitre by heat, and obtained a gas composed of one volume azote and two volumes oxygen: our number would require one volume azote and $2\frac{1}{2}$ volumes oxygen. I shall give a translation of this paper of Berthollet in the next article of the present number, because I wish to draw the attention of chemists to it. I do not know very well how to account for this discordance between the results of Berthollet and those of other chemists. Perhaps the half volume of oxygen wanting may have combined with the potash. I may, hereafter, relate the result of a set of experiments which I mean to undertake on purpose to elucidate this point. Till then I think it safest to abide by the number 1·75 for the weight of an atom of azote.

		Weight of an atom.
13	Potassium	5·000
14	Sodium	3·000
15	Calcium	2·625
16	Barium	8·750
17	Strontium	5·500
18	Magnesium	1·500 [g]
19	Potash	6·000 [h]
20	Soda	4·000 [i]

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difficulty than those upon other metals. The number 4·75 results from the compounds which arsenic forms with oxygen; but it does not agree well with the chloride of arsenic. Besides, if 4·75 be the weight of an atom of arsenic, neither arsenious nor arsenic acid will contain whole atoms of oxygen; for the first will be a compound of 1 atom arsenic + 1¼ atom oxygen, and the second of 1 atom arsenic + 2¼ atoms oxygen. These anomalies render it very unlikely that an atom of arsenic really weighs 4·75.

[g] But few changes have been made upon the weights of the atoms of these six alkaline metals. The supposition that an atom of sodium weighs three, tallies very well with experiments, if we suppose soda to be a compound of 1 atom sodium + 1 atom oxygen. On that supposition soda will weigh 4, which agrees with the weight resulting from the composition of the salts of soda. The number for strontium results from the mean of Stromeyer's analyses of the salts of strontian, and my own. The number for magnesium is founded on Berzelius's analysis of sulphate of magnesia.

[h] This number is very convenient, and it tallies as well with the analyses of the salts of potash as any other.

	Acid.		Potash.
Kirwan found sulphate of potash composed of	45·20	+	54·80
Wenzel	45·30	+	54·70
Thomson	45·72	+	54·28
Mean	45·40	+	54·60
If it be a compound of 5 acid + 6 potash, its constituents are	45·46	+	54·54

I consider this as almost an exact coincidence.

[i] This number agrees equally well for soda.

	Water.		Acid.		Soda.
Berzelius found sulphate of soda composed of	56	+	24·76	+	19·24
If it contains 5 acid + 4 soda, its constituents will be	56	+	24·40	+	19·60

		Weight of an atom.
21	Lime	3·625 [k]
22	Barytes	9·750 [l]
53	Strontian	6·500 [m]
24	Magnesia	2·500 [n]
25	Yttrium	4·000
26	Yttria.	5·000 [o]

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[k] If sulphate of lime be a compound of 5 acid + 3·625 lime, its constituents will be

	Acid.		Lime.
	57·97	+	42·03
Berzelius's analysis gives us	58·00	+	42·00

which may be considered as an exact coincidence.

[l] If sulphate of barytes be composed of 5 acid + 9·75 barytes, its constituents will be

	Acid.		Barytes.
	33·90	+	66·10
Mr. Arthur Aikin's analysis gives	33·96	+	66·04
Berzelius and Fourcroy found	34·00	+	66·00

[m] Carbonate of strontian, supposing it a compound of 2·75 acid + 6·5 strontian, should consist of

	Acid.		Strontian.
	29·73	+	70·27
I found its constituents to be	29·90	+	70·10

If sulphate of strontian be a compound of 5 acid + 6·5 strontian, its constituents should be

	Acid.		Strontian.
	43·48	+	56·52
Stromeyer found it	43·00	+	57·00

These coincidences are sufficiently near. The deviations are on opposite sides; so that the mean of the two would almost tally with our theoretic number.

	Acid.		Magnesia.
[n] Berzelius found sulphate of magnesia composed of	66·64	+	33·36
If it be a compound of 5 acid + 2·5 magnesia, its constituents will be	66·60	+	33·30

This coincidence I consider as exact.

[o] According to Berzelius (Afhandlingar, iv. 236), sulphate of yttria is composed of equal weights of acid and base. Hence an atom of yttria weighs the same as an atom of sulphuric acid. The weight of an atom of yttrium is conjectural. It is founded on the supposition that yttria is a compound of 1 atom yttrium

		Weight of an atom.
27	Glucinum	2·250
28	Glucina	3·250 [p]
29	Aluminum	1·125
30	Alumina	2·125 [q]
31	Zirconium	4·625 ?
32	Zirconia	5·625 ?
33	Iron	3·500
34	Protoxide of iron	4·500 [r]
35	Peroxide of iron	10·000 [s]
36	Nickel	3·375
37	Protoxide of nickel	4·375 [t]

+ 1 atom oxygen; but we have no means of determining whether the supposition be well or ill founded. It would be necessary to determine the weight of oxygen and metal in yttria before we could be quite certain.

[p] According to Berzelius, sulphate of glucina is a compound of

	Acid.		Glucina.
	100	+	64·100
If it be composed of 5 acid + 3·25 glucina, its composition will be	100	+	65·000

[q] This number is founded upon Berzelius's analysis of sulphate of alumina.—(Ann. de Chim. lxxxii. 14.)

	Acid.		Alumina.
He found it a compound of	100	+	42·722

Now 100 : 42·722 :: 5 : 2·115. I take 2·125 as sensibly the same with 2·115. Mr. Richard Philips informs me that he has analysed the sulphate of alumina with a different result; that the quantity of alumina which he found in the salt was much greater. Should this statement turn out correct, the weight of an atom of alumina would be higher than it is stated above, and might even amount to 3·5, the number in my original table.

[r] According to Berzelius's analysis of sulphate of iron, the weight of protoxide of iron is 4·4. He found it a compound of 28·9 acid + 25·7 protoxide of iron + 45·4 water. Now 28·9 : 25·7 :: 5 : 4·4. I have adopted 4·5 as sufficiently near the number. The mean of all the analyses of protoxide of iron gives us 100 iron + 28·78 oxygen. If we consider protoxide of iron as a compound of 1 atom iron + 1 atom oxygen, and its weight to be 4·5, then it will be a compound of 100 iron + 28·57 oxygen. These coincidences are sufficiently near.

[s] My reasons for pitching upon this number for the weight of an atom of peroxide of iron have been given in the *Annals of Philosophy*, x. 98.

[t] I am not quite satisfied with this number, though it is

		Weight of an atom.
38	Peroxide of nickel	9·750 [u]
39	Cobalt	3·625
40	Protoxide of cobalt	4·625 [w]
41	Peroxide of cobalt	10·250
42	Manganese	3·500
43	Protoxide of manganese	4·500 [x]
44	Peroxide of manganese	5·500
45	Uranium	15·625
46	Protoxide of uranium	16·625 [y]

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founded on the best data to be had, and cannot be very far from the truth. Tupputi found sulphate of nickel composed of acid 100 + 87·26 protoxide of nickel. Now 100 : 87·26 :: 5 : 4·362; so that the weight of an atom of protoxide of nickel is 4·362: 4·375 scarcely differs from this number. I prefer it, because it is a multiple of 0·125. The average of the analyses of the protoxide of nickel (omitting Proust's) makes it a compound of 100 metal + 28·74 oxygen. This shows us that it must be a compound of 1 atom metal + 1 atom oxygen. If so, the true proportions must be 100 metal + 29·63 oxygen.

[u] This supposes it a compound of 2 atoms metal + 3 atoms oxygen. It contains 1½ times as much oxygen as the protoxide.

[w] This number is derived from the analysis of protoxide of cobalt by Rothoff, who found it a compound of 100 metal + 27·3 oxygen. If it be a compound of 1 atom metal + 1 atom oxygen, an atom of the metal must weigh 3·663; but the atoms of carbon, oxygen, azote, phosphorus, and sulphur, which have been ascertained with the greatest precision, are multiples of 0·125, or an atom of hydrogen. Hence I suspect that all the atoms, if accurately ascertained, would be multiples of hydrogen: 3·663 not being a multiple of ·125, I take 3·625, which is the nearest multiple as the weight of an atom of cobalt: of course the protoxide must be 4·625. Rothoff has shown that the oxygen in the peroxide is 1½ times as much as that in the protoxide. Supposing the peroxide composed of 2 atoms metal + 3 atoms oxygen, its weight will be as in the table.

[x] From John's analysis of sulphate of manganese, the weight of protoxide comes out 4·6; from his analysis of the carbonate, it comes out 4·495. I conceive, therefore, that 4·5 is probably the true weight. The peroxide of manganese has never been accurately analyzed; but there can be little doubt that it contains just twice as much oxygen as the protoxide. I believe the red oxide of manganese, which is intermediate between the other two, not to be a particular oxide, but a compound of protoxide and peroxide. It does not seem capable of uniting with other bodies.

[y] *The experiments* of Schoübert lead to the conclusion that

		Weight of an atom.
47	Peroxide of uranium	34·250
48	Cerium	5·750
49	Protoxide of cerium	6·750 [a]
50	Peroxide of cerium	14·500
51	Zinc	4·125
52	Oxide of zinc	5·125 [b]
53	Lead	13·000
54	Protoxide of lead	14·000 [c]

---

protoxide of uranium is a compound of 100 metal + 6·373 oxygen. This would make the weight of an atom of uranium 15·691. I take 15·625 as the nearest multiple of ·125. Schoübert has shown that the peroxide contains 1½ times as much oxygen as the protoxide. It must, therefore, be a compound of 2 atoms metal + 3 atoms oxygen, and its weight must be as in the table.

[a] The numbers for cerium and its oxides are derived from the experiments of Hisinger. From his analysis of the salts of cerium, it is probable that the protoxide is composed of

Cerium	100·00
Oxygen	17·41

and the peroxide of

Cerium	100·000
Oxygen	26·115

Now if we suppose the protoxide a compound of 1 atom metal + 1 atom oxygen, and the peroxide of 2 atoms metal + 3 atoms oxygen, we obtain the numbers in the table.

[b] Zinc combines with only one dose of oxygen. Berzelius and Gay-Lussac found the oxide composed of 100 metal + 24·4 oxygen; while I obtained 100 metal + 24·16 oxygen. According to the first of these results, an atom of zinc weighs 4·098; according to the second, 4·139. The mean of both gives 4·118. Now 4·125 (which I prefer, because it is a multiple of ·125) differs very little indeed from this number.

	Acid.		Oxide of lead.
[c] Berzelius found sulphate of lead composed of	26·32	+	73·68

Now 26·32 : 73·68 :: 5 : 13·996; a number which approaches so near 14 that there can be little hesitation in pitching upon 14 as the true number. Of course the number for lead must be 13. Berzelius has shown that peroxide of lead contains twice as much oxygen as protoxide. Hence it must weigh 15. I consider *red lead* as a compound of protoxide and peroxide.

		Weight af an atom.
55	Peroxide of lead	15·000
56	Tin	7·375
57	Protoxide of tin	8·375 [d]
58	Peroxide of tin	9·375
59	Copper	8·000
60	Protoxide of copper	9·000
61	Peroxide of copper	10·000
62	Bismuth	8·875
63	Oxide of bismuth	9·875 [e]
64	Mercury	25·000
65	Protoxide of mercury	26·000
66	Peroxide of mercury	27·000
67	Silver	13·750 [f]
68	Oxide of silver	14·750
69	Gold	24·875
70	Protoxide of gold	25·875 [g]
71	Peroxide of gold	27·875
72	Platinum	22·625
73	Protoxide of platinum	23·625 [h]

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[d] This number is deduced from the experiments of John Davy, which are a mean of those of Gay-Lussac and Berzelius, and make protoxide of tin a compound of 100 tin + 13·55 oxygen. This gives 7·375 for an atom of tin, and 8·375 for an atom of protoxide. There can be no doubt, from the experiments of the same chemists, that peroxide of tin contains twice as much oxygen as protoxide. Hence the weight of an atom of it must be 9·375.

[e] This number almost coincides with Lagerhjelm's analysis of oxide of bismuth, which I think the most accurate analysis. He found it a compound of 100 bismuth + 11·275 oxygen. Now 11·275 : 100 :: 1 : 8·869. This number differs very little from 8·875, which, being a multiple of ·125, has been adopted.

[f] This number is derived from the analysis of chloride of silver, which, according to Dr. Marcet, is composed of 24·53 chlorine + 75·47 silver; according to Gay-Lussac, of 24·75 chlorine + 75·25 silver: the mean of these is 24·64 chlorine + 75·36 silver. Now 24·64 : 75·36 :: 4·5 : 13·75 very nearly.

[g] The weight of an atom of gold and of its oxides are derived from the analyses of the oxides of gold by Berzelius. I have no great confidence in these numbers, because I have doubts how far the accuracy of the method followed by Berzelius is to be depended on

[h] The weight of the protoxide of platinum, and consequently of platinum itself, is founded upon the analysis of protoxide of platinum by Mr. Cooper, the discoverer of it. He found that

		Weight of an atom.
74	Peroxide of platinum	25·625
75	Palladium	7·000 [i]
76	Oxide of palladium	8·000
77	Rhodium	15·000 [k]
78	Protoxide of rhodium	16·000
79	Deutoxide of rhodium	17·000
80	Peroxide of rhodium	18·000
81	Iridium	6·000 [l]
82	Antimony	5·625 [m]

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100 grains of this oxide, when heated to redness, give off $12\frac{1}{2}$ cubic inches of oxygen gas, and are reduced to the metallic state. Hence protoxide of platinum is a compound of 100 metal + 4·423 oxygen. Hence the number for platinum and protoxide of platinum. The number for the peroxide is rather conjectural. The experiments of Berzelius and Edmond Davy on the oxides and other compounds of platinum do not agree with each other.

[i] The weight of palladium and its oxide is founded on the experiments of Berzelius. He found the oxide a compound of 100 metal + 14·209. The number 7 supposes the oxide a compound of 100 metal + 14·285 oxygen, which does not materially differ from the result obtained by Berzelius.

[k] The weight of rhodium and its three oxides are deduced from the experiments of Berzelius; but I do not think that much confidence can be put in their accuracy, they were made upon so small a scale. He makes the composition of the three oxides as follows:

		Oxygen.	
Protoxide	100 metal +	6·71	or 1 atom
Deutoxide	100 metal +	13·42	.. 2 atoms
Peroxide	100 metal +	20·13	.. 3 atoms

[l] According to Vauquelin, sulphuret of iridium is a compound of 3 metal + 1 sulphur. This gives the weight of an atom of iridium 6, if the sulphuret be composed of 1 atom metal + 1 atom sulphur.

[m] I have deduced this number from a very careful analysis which I made of sulphuret of antimony; I found it composed of 100 antimony + 35·572 sulphur. Now 35·572 : 100 :: 2 : 5·625. The protoxide of course must be 6·625. This agrees nearly, though not quite, with Berzelius's analysis. According to him, protoxide of antimony is a compound of 100 metal + 18·6 oxygen. According to the number which I have adopted, it is composed of 100 metal + 17·775 oxygen. The peroxide has never been analyzed; but there is reason to believe that it contains twice as much oxygen as the protoxide. The deutoxide is

		Weight of an atom.
83	Protoxide of antimony	6·625
84	Deutoxide of antimony	20·875 ?
85	Peroxide of antimony	7·625
86	Chromium	3·500
87	Chromic acid	6·500 [n]
88	Molybdenum	6·000 [o]
89	Protoxide of molybdenum	7·000
90	Deutoxide of molybdenum	8·000
91	Molybdic acid	9·000
92	Tungsten	12·000
93	Protoxide of tungsten	14·000
94	Peroxide of tungsten	15·000 [p]

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obtained by heating protoxide or peroxide to redness. The oxygen in it is to that in the protoxide as 4 to 3. Hence we may conceive it to be a compound of 3 atoms metal + 4 atoms oxygen: this would make its weight 20·875; but this seems too complicated a compound to be the true representation of the composition of this oxide. Further experiments are requisite to elucidate this subject.

[n] Chromate of lead, according to Berzelius, is composed of 100 acid + 213·841 protoxide of lead; and chromate of barytes, of 100 acid + 149·066 barytes. From the first salt, it follows that an atom of chromic acid weighs 6·547; from the second, that it weighs 6·541. I have, therefore, taken 6·5 as the true weight. As there are three oxides of chromium, it is probable that the peroxide or chromic acid contains 3 atoms of oxygen. On that supposition an atom of chromium will weigh 3·5, as in the table.

[o] Molybdate of lead, according to the analysis of Berzelius, is composed of 100 molybdic acid + 155·15 protoxide of lead Now 155·15 : 100 :: 14 : 9·023. Hence 9 appears to be the weight of an atom of molybdic acid. Now as molybdenum forms three different oxides, I conceive the first to be a compound of 1 atom molybdenum + 1 atom oxygen; the second, of 1 atom molybdenum + 2 atoms oxygen; and the third, of 1 atom molybdenum + 3 atoms oxygen. Hence the weight of an atom of molybdenum and of its three oxides, as given in the table.

[p] Tungstate of lime, according to Berzelius, is composed of 100 tungstic acid + 24·12 lime. Now 24·12 : 100 :: 3·625 : 15·03. I, therefore, consider 15 as the weight of an atom of tungstic acid. It seems proved that tungstic acid is a compound of 4 metal + 1 oxygen. If we divide 15 in this ratio, we get 12 metal + 3 oxygen. Hence an atom of tungsten must weigh 12; and tungstic acid must consist of 1 atom metal + 3 atoms oxygen. According to Berzelius, brown oxide of tung-

		Weight of an atom.
95	Columbium	18·000
96	Oxide of columbium	19·000 [q]
97	Titanium	18·000 ? [r]
98	Protoxide of titanium	19·000 ?
99	Deutoxide of titanium	20·000 ?
100	Peroxide of titanium	21·000 ?
101	Ammonia	2·125 [s]

I shall not continue this table any further at present, as I conceive that the article has already extended to a sufficient length. In the next number of the *Annals*, I shall give the weight of the acids, and of such inflammable compounds as have been analyzed with tolerable accuracy. I shall then proceed to the salts, and to the vegetable and animal substances, a few observations on the constitution of which I think may be useful in the present state of our knowledge. It may have a tendency to prevent our indulging in theory before we have obtained the requisite data.

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sten contains two-thirds of the oxygen of tungstic acid. Hence the number for it in the table.

[q] Little confidence can be put in the numbers in the table which represent columbium and its oxide. If we suppose oxide of columbium to be a compound of 1 atom metal + 1 atom oxygen, and that it is composed of 100 metal + 5·5 oxygen, the numbers in the table will result from the supposition. Now Berzelius found by experiment that oxide of columbium was a compound of 100 metal + 5·485 oxygen. This I consider as a very near coincidence.

[r] These numbers are merely conjectural.

[s] I consider it as demonstrated that ammoniacal gas is a compound of three volumes of hydrogen and one volume of azotic gas reduced to two volumes. Now this is the same thing as if we said that it is a compound of three atoms hydrogen and one atom azote.

ARTICLE IV.

Experiments on the Proportion of the Elements of Nitric Acid.

By M. Berthollet.*

I HAVE endeavoured, by a method hitherto neglected, to ascertain the proportions of oxygen and azote in nitric acid, *respecting* which chemists are not agreed.

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* Translated from the Memoires d'Arcueil, vol. iii. p. 105.

I employed the decomposition of nitrate of potash by heat; one of the first chemical experiments which I ever made.*

The capacity of a luted porcelain retort was ascertained by filling it with fine sand: 15 grammes (231·66 gr. troy) of pure and dry nitre were put into it. From the beak of this retort, a tube passed to a stop-cock, which was fixed in the upper end of a glass jar filled with water, and standing upon the water trough. The retort was heated at first slowly, and at last exposed to all the heat of a reverberatory furnace, surmounted with a tube six decimetres (29·6 inches). The whole was allowed to cool. Water was then poured into the water trough till the surface of the water in the jar and the trough were upon a level. The stop-cock was now shut, and the retort broken; the potash was found united with the surface of the porcelain. Sulphuric acid being poured upon this compound, no effervescence took place. This shows us that the nitre had been entirely decomposed, and that the potash had not retained oxygen. However, there was sublimed in the tube a small quantity of salt which weighed nine centigrammes (1·4 grain), and was a mixture of nitrite and nitrate.

The bulk of the gas disengaged was 4·8073 litres (293·38 cubic inches); at the temperature of 53·6°, and when the barometer stood at 0·7613 metre (29·973 inches), the volume of gas contained in the retort before the experiment was 0·2997 litre (18·29 cubic inches).

Four analyses were made of the gas collected in the glass jar, three by means of Volta's eudiometer, and one by means of the hydroguretted sulphuret of lime saturated with azote. The results were as follows:

First analysis	65·96 per cent of oxygen.
Second ditto	65·98
Third ditto...............	66·16
Fourth ditto	66·00
Mean	66·02

It was supposed that the gas remaining in the retort after the process was precisely similar to that in the glass jar; because the communication was very free, and the great change of temperature which took place ought to have occasioned an equal mixture.

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* I presented on Jan. 17, 1778, to the Academy of Sciences, a memoir, in which I showed that the acid of nitre could be entirely converted into gas by the action of heat, or at least that the only portion not thus changed was quite insignificant; that by that method 580 cubic inches of gas might be obtained from an ounce of nitre: that this gas consisted chiefly of oxygen, which afforded an explanation of the effects of nitre upon charcoal and sulphur: that dried nitre contained no sensible quantity of water; and that at a certain stage of the decomposition the nitrate was changed into a *phlogisticated nitre*, or into a nitrite, which preserved its neutrality.—Memoires de l'Academie des Sciences, 1781.

The volume of gas disengaged added to that of the air in the vessels before the experiment forms a total volume of 5·07 litres, which, according to the preceding analysis, are composed of 3·3716 litres of oxygen and 1·7354 of azote, from which we must subtract 0·0629 of oxygen and 0·2368 of azote, which constituted the atmospherical air of the apparatus. Hence the nitric acid was composed of 3·3037 litres (201·92 cubic inches) of oxygen and 1·4986 litres (91·456 cubic inches) of azote. This makes the composition of nitric acid in volume

Azote	100·00
Oxygen	220·78

The experiment was repeated with the same quantity of nitre; but to avoid the sublimation which took place in the former one, the fire was much more cautiously raised; and in fact no sublimation took place. To ascertain the capacity of the retort and tube with more precision, it was filled with water after the experiment, which was afterwards poured into a graduated cylinder.

The result of this experiment was, that in nitric acid 100 litres of azote are combined with 222·96 of oxygen.

From a third experiment it results, that 100 litres of azote are combined with 222·58 of oxygen.

The mean of the three experiments gives for 100 of azote 222·10 of oxygen.

If we convert these proportions into weights, we find that nitric acid is composed of

Oxygen.		Azote.
69·92	+	30·38
100·00	+	43.65

My experiments give a proportion of oxygen a little smaller than that which is adopted by Dalton, who admits for 100 measures of azote 133 measures of oxygen, a proportion which differs little from the results of Cavendish and Davy.

Towards the end of the decomposition of the nitrate, the receiver acquires a red colour; but as the nitrous gas indicated by that colour is found in contact with an excess of oxygen, it ought to be again converted (at least chiefly) into nitric acid, and of course produce little alteration in the ratio of the oxygen and azote as indicated by the experiment.

This quantity of nitric acid which is again formed is so small that it cannot even alter sensibly the absolute weight of the acid, as determined by the weight of the gases disengaged. This I ascertained by passing through a small quantity of water all the gas disengaged during the process. This fact had been already constated by Lavoisier and Bacquet, who were employed by the Academy of Sciences to examine the memoir of which I have spoken.

If we employ the products of this decomposition to determine the proportion of acid in dry nitrate of potash, we find, by calculating the products of the first experiment, that 100 parts of the salt are composed of

Acid	49·9
Potash	50·1
	100·0

When we calculate the other experiments, the results vary merely a few thousandth parts. Hence it follows from these experiments that nitre is composed of equal weights of acid and potash.

This method gives, perhaps, a nearer approximation than those which are founded on the composition of any other salt, respecting which there must of necessity be a greater or smaller degree of uncertainty.

Note by the Editor.—Though I cannot pretend to account for the source of the fallacy, I have not the least doubt that the constitution of nitric acid, as deduced from the preceding experiments, is inaccurate. It has been sufficiently established that an atom of oxygen gas may be represented by one volume, and an atom of azotic gas by two volumes. We may of course obtain the atoms that enter into combination, by simply doubling the volume of the oxygen gas. If we do this, we see that, according to Berthollet's experiments, nitric acid is a compound of 1 atom azote + 4·442 atoms of oxygen. Now it is quite obvious that the fractional part of an atom amounting to 0·442 cannot possibly exist as a constituent. Instead of 100 azote + 222·1 oxygen, the true number ought to be 100 azote + 250 oxygen. If any one prefers the theory of volumes, as explained by Gay-Lussac, and adopted by Berzelius, to the atomic theory, the objection is not in the least diminished; for, according to that theory, one volume of azote can combine only with a certain number of volumes of oxygen, and not fractional parts of a volume, as is indicated by the experiments of Berthollet.

But it is easy to show by experiment that the composition of nitrate of potash is not what Berthollet has deduced from his experiments. I took 100 grains of pure and dry nitre, poured sulphuric acid upon the salt in a platinum crucible, and exposed it to a heat at first low, but gradually increased till it became sufficiently intense to decompose bisulphate of potash. The residual sulphate of potash weighed 83·6 gr.; but 83·6 of sulphate of potash contain 45·6 potash; therefore, nitre is composed of

Nitric acid	54·4
Potash	45·6
	100·0

Proportions very different from those of Berthollet, namely,

Nitric acid	49·9
Potash	50·1
	100·0

It is obvious that in Berthollet's experiments 4·5 gr. of the nitric acid were lost, and this loss seems to have fallen chiefly, if not entirely, upon the oxygen. Let us deduce the weight of an atom of nitric acid from my experiment. We have 45·6 : 54·4 :: 6 : 7·158. The weight of an atom of nitric acid comes out 7·158, which I believe to exceed the truth somewhat. It seems obvious, therefore, that my mode of experimenting has a tendency to increase the quantity of acid somewhat above the truth; so that some of the potash must have been sublimed. Probably the error might be diminished by employing sulphate of ammonia instead of sulphuric acid to decompose the nitre. It is obvious that a much lower heat at least would be requisite. I intend to repeat the experiment in this way; and may state the result hereafter.

In the mean while, as the errors in the two experiments lie on different sides, the probability is, that the mean of the two will come very near the truth. Such a mean will give for the composition of nitre,

Nitric acid	52·15
Potash	47·85
	100·00

Now 47·85 : 52·15 :: 6 : 6·539. This weight, 6·539, though not absolutely correct, is undoubtedly much nearer the truth than either the number derived from Berthollet's experiment or mine.

Dr. Wollaston made an experiment which was susceptible of very considerable precision. He saturated a given weight of bicarbonate of potash with nitric acid, and ascertained the weight of the nitre resulting. Nitre turned out a compound of 100 acid + 86·764 potash. This is equivalent to

Nitric acid	53·543
Potash	46·457
	100·000

The error in this experiment lies upon the same side as in mine, but it is smaller. Both errors are not more than sufficient to counterbalance Berthollet's error on the opposite side. Therefore, if we take the mean of all the three, we must obtain a result which will approach still nearer accuracy. This mean gives us nitre composed of

Nitric acid............	52·6143
Potash................	47·3856
	100·0000

Now 47·3856 : 52·6143 :: 6 : 6·662. I consider 6·75 as the true weight of an atom of nitric acid. Now 6·662 approaches very near that weight.

No person would believe who has not tried it how exceedingly difficult it is to attain absolute precision in chemical experiments. I am persuaded that we can reach that very desirable object in no other way than by taking care that the errors fall upon different sides, and then taking the mean of a greater number of experiments. If we were in possession of three other sets of experiments made with the same care as those of Berthollet, Wollaston, and my own, upon the analysis of the same salt, I am persuaded that by taking the mean of all the six, we should approach the truth very nearly indeed. The error even from the three does not much exceed one per cent.

Article V.

A Barometrical Measurement of the Profile of Mount Jura, on the Line of Geneva,—Lons-le-Saunier, by successive Observations, while corresponding ones were made at Geneva, Strasburg, and Paris. Executed in 1813 *with a Barometer of Fortin, during the Course of a Geodesical Examination. With a Critical Comparison of the Barometrical Measurements with those obtained by Zenith Distances.* By M. Delcros, Captain of the Royal Corps of French Geographical Engineers.*

(With a Plate.)

Barometrical measurements would be very limited and almost useless if, as some philosophers seem to insinuate, they were only practicable when we have corresponding and nearly vertical observations to compare together. I am of opinion, from my own observations, that this valuable mode of measurement may be much further extended, and that it presents an infinite number of applications, which must be useful to the geologist, to the naturalist, to the soldier, and to engineers in general.

It is of the more importance to point out all possible means of levelling, because hitherto *stational topography* has hardly entered into the class of operations by which engineers describe the surface of the earth. We possess excellent plane topographical accounts; but these labours, though brought to great perfection in this respect, are still absolutely defective as far as profile is concerned. The method attempted of expressing heights by different kinds of shading is exceedingly vague and unsatisfactory. Every person acquainted with the modern improvements, and aware of the importance of a complete and precise topography, would prefer the *arid* description of a northern geometer to the *sweet* harmony imported from Italy. I appeal from my own judgment to that of all the civil and military engineers of all nations. Let not the caprice of fashion and the necessity of yielding to its dictates be alleged. To call in the assistance of painting to that class to whom topographical charts are useless, is to attempt a geographical description of parlours and boudoirs. It is as if we wished to transform the mathematical precision of the *Mecanique celeste* into familiar conversations on the world.

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* Translated from the Bibliotheque Universelle, vii. 164, for March, 1818.

The present time may be considered as favourable for the improvement of topography. All nations are eager to introduce into it the *rigorous* methods which are adapted to it. War could form only engineers skilled in giving a rapid and picturesque, but vague idea of the country which they were called upon to describe. The leisure of peace permits us to demand a superior degree of perfection. Engineers formed in the first schools of Europe promise us what we have long desired. They are qualified to fulfil our expectations. Let us not offer them the seducing picture of romance—let us be as rigid and as sage in geography as we are in literature. We possess engineers who are excellent in planimetry. Nothing can exceed the perfection with which they exhibit the horizontal projections of countries; but another step still remains, which cannot be difficult for men of such skill. Let us take care neither to retard nor to stop this progressive motion, or to convert it into a retrograde motion by allegations of superannuated authorities. In the sciences, as in the arts, let us never look behind us, except to admire the progress which has been made, and of which we should rather be the emulators than the servile imitators. I have no hesitation to say that a true topographical school, founded on the complete study of the surface of the earth, is still wanting in France and in Europe. When it is formed, and when the complete science of geology is taught in it, we shall then possess engineers capable of describing and expressing every thing.

Among the improvements proposed for obtaining a good geometrical description of the topography of places adapted for public service, a complete levelling has been proposed, expressed upon charts by the projections of the equidistant curves of the level resulting from the common section of the surface of the ground, with a series of horizontal planes equidistant in a vertical direction. This method is perfect. It is absolutely necessary *in order to* arrive at the end proposed. Vertical topography is one of the most important bases of every geographical description; without it we can form no idea of the form and relations of the ground. I consider this kind of information as the most important of all. In fact, it is often of less consequence to the engineer to be acquainted with the horizontal distance of an object exactly, than to know its relative height. In all cases, both civil and military, the relation of height is of primary importance. A topography which leaves it out has only the appearance of being useful.

The difficulty, the tediousness, and the inaccuracy of geometrical levellings may be objected; and I admit these objections. Great geodesical levellings formed by the sole practicable system, reciprocal zenith distances taken at different times, are influenced by the anomalies of terrestrial refraction. A good system of previous observations in which all the effects of perturbations were combined, would furnish, it is true, a complete suite of circumstantial co-efficients. But this great undertaking is still to commence. Topographical levellings, executed by means of angular data, besides their dependance on horizontal distances and vertical bases, are extremely tedious and delicate. They suppose an exact planimetry; they are affected by the inappreciable irregularities of refraction. The series of absolute heights thus determined is subject to accumulations of errors, which the probable compensation of opposite errors can but ill obviate. In countries exposed to violent changes, the difficulties, and with them the errors, augment. Very steep declivities often are beyond the limits of the instruments: the horizontal bases, which are less exact in such countries, combined within accurate angles, affect the levels with a degree of uncertainty which may be very considerable.

The difficulties and imperfections which I have pointed out belong to the most favourable case of all, when the engineer is furnished with proper instruments to give the zenith distances; and when he possesses a very exact planimetry of the country to be levelled; and when several absolute heights are already accurately determined; when he has sufficient leisure, the means of marking out the different signals, &c. &c. But how far is the solitary geologist, naturalist, or engineer, from this advantageous position! Horizontal bases, the means of measuring them, a sufficient number of known points, exact instruments, and time itself, that fugitive element which presses so much upon the travelling geologist, are here all wanting. Whole ages would not be sufficient to enable an engineer to obtain the complete vertical topography of a country of moderate extent; and yet the geologist and the geographer are often under the necessity of levelling with rapidity, and of determining in a few days the whole profiles of systems of mountains, of which he rarely possesses a tolerable chart, and never an exact planimetry.

Without the assistance of the barometer such a situation *would be desperate.* This instrument, so simple, so precious so little known, so little valued, so despised, may be employed with advantage, and may come in place of the impracticable system of geometrical levelling.

The idea of employing the barometer for vertical topography is neither mine nor is it new. All the philosophers who have become practically acquainted with this instrument have recommended it. De Saussure and De Luc may be considered as its creators; after them, Ramond, Humboldt, Pictet, Prony, De Buch, &c. have either applied it or brought it to the greatest degree of perfection. It is with the greatest diffidence that I offer my observations after the immortal labours of these illustrious geologists.

Notwithstanding the encouraging example of all these philosophers, the use of the barometer is still very much neglected. Mathematicians despise it without attempting to become practically acquainted with it. Naturalists, more disposed to adopt it, are afraid of venturing to apply it, and generally neglect it. I do not flatter myself that I shall prevail upon these different classes of observers to make use of the barometer; I shall merely add a few facts to the mass already collected.

Barometrical measurements may be obtained by two methods. 1. By a system of corresponding observations made at the same time. 2. By suites of successive observations not made at the same time, but sufficiently near to answer the same purpose as if they were contemporary.

The first of these methods supposes corresponding observations made at points previously agreed upon, and with barometers compared with each other. But it is often difficult to obtain these two conditions, and they keep the observer absolutely dependant on his base. In extensive measurements he is soon too far from the corresponding points to be able to reckon on the exactness of the comparisons.

The second method may be of the greatest utility, in consequence of its perfect independence, of its rapidity, and I may say, likewise, in consequence of its exactness. This method, like the former, supposes us to set out from a known base; but when once set out, we become independent of it. Let us figure to ourselves the astonishing rapidity with which we can measure the height of whole regions and of lines of immense extent, and we shall be able to form a conception of this method. The want of correspondence of successive observations will no doubt be objected to me. I cannot deny this inconvenience; but it becomes very small if the observer abstains from observing when obviously disturbing causes intervene; and if he multiplies his observations so as to have them at intervals of half an hour from each other, then his errors will be smaller than if he were obliged to employ corresponding observations at the horizontal distance of 20, 30, or 50 leagues.

We can almost always combine these two methods, which will thus throw light upon and verify each other. This I sometimes did formerly; but I propose to do it more frequently hereafter, now that I know the advantages of it. I have already given to the public a partial measurement of Mount Ventoux. I mean at present to give the profile of Mount Jura on the line from Geneva to Lons-le-Saunier and the chateau Mirebel. A rapid examination of it which I made in 1813, to ascertain some geodesical points, furnished me with an opportunity for determining it. I regret that the little time I had at my disposal, and the length of time which an observation of Fortin's barometer requires, did not allow me to make so many as I could have wished. But notwithstanding this great inconvenience, the reader will be astonished at the results which I have obtained from successive observations often made at an interval of several hours, and from other corresponding ones made at Paris, Geneva, and Strasburg.

The table which I give in the first place exhibits in four columns the principal successive observations, and the corresponding ones which I could collect. It will be observed how far my successive heights are from each other.*

Having interrupted the suite of my observations, I divide them into three series, which I place in the order in which they were made.

I shall not state here the particular calculations which I have made of all the combinations of the observations in this table. I shall be satisfied with arranging together the results which they have furnished in a single table, the first columns of which give the simple heights of the stations by successive observations. In the four succeeding columns I shall give the absolute heights of these same stations determined from a comparison of the corresponding observations made at Geneva, Strasburg, and Paris. The last four columns, in which I shall collect the differences of these results, will show the errors to which we are exposed in unfavourable circumstances, and will enable us to foretell their limits in more advantageous cases; that is to say, when the corresponding observations are made at places less remote, and when the successive observations are nearer each other in respect to time and horizontal space.

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* We suppress this table, because its great bulk would render the printing of it rather embarrassing. We shall confine ourselves to the results of the observations. —(Note by the editors of the Bibliotheque Universelle.)

s of the stations where essive observations were e.	Numbers given by Oltman's tables.	Calculation of the height of the stations by successive observations.					Height of the stations above the sea by simultaneous corresponding observations at				Difference of the results given by successive obversations from those obtained by corresponding observations made at			
		Corrections.			Difference between the height of the stations.	Mean height of ditto above the sea.	Geneva. 400 metres above sea.	Strasburg, 151·52 m. above the sea.	Paris, 71·94 m. abo e sea.	Means.	Geneva.	Strasburg.	Paris.	Means.
		Temperature.		Mean latitude.										
		Mercury.	Air.											
	Metres.					Metres.								
a, botanic garden........ t 0·63 metres aboveground	5801·33 5607·80	+ 6·35	+12·10	+0·60	+ 212·58	400·0 611·95	612·58	605·20	—	608·89	−0·63	+6·75	—	+3·06
ost house............... Mount Colombier.......	5607·80 4555·86	−12·40	+48·63	+3·10	+1091·27	1703·22	1701·27	1705·40	1700·59	1702·42	+1·95	−2·18	+ 2·63	+0·80
f Mount Colombier....... le.......................	4559·00 4914·63	− 0·90	+12·69	+1·10	− 368·52	1334·70	—	1328·18	—	—	—	+6·52	—	—
le....................... x, at the inn	4914·63 5225·33	− 7·10	+10·49	+0·90	− 314·99	1019·71	1027·26	1017·12	—	1022·19	−7·55	+2·59	—	−2·48
k....................... erie, near Sept-Moncel...	5232·92 5064·38	− 2·75	+10·00	+0·45	+ 176·24	1195·95	1201·34	1200·07	—	1200·70	−5·39	−4·12	—	−4·75
erie, near Sept-Moncel... Replan.................	5064·38 5215·42	− 3·35	+ 8·55	+0·45	− 156·69	1039·26	1046·50	1047·27	—	1046·88	−7·24	−8·01	—	−7·62
e Replan............. ude, Inn Devaux ; Ground	5215·42 5774·28	+ 4·70	+32·43	+1·80	− 597·79	441·47	—	449·53	—	—	—	−8·06	—	—

nd Series, *setting out at Lons-le-Saunier, lower than Geneva* 131·44 *Metres, and above the Sea* 268·56 *Metres, as deduced from a Series of simultaneous corresponding Observations.*

le-Saunier, at 6·02 metres ve ground.............. nating point, route to-Orgelet	6028·04 5763·10	+ 0·75	+18·03	+0·70	+ 284·42	268·56 552·36	—	550·52	—	—	—	+1·84	—	—
nating point, towards Or-................. near Gargaille	5763·10 5746·22	0·00	+ 1·17	0·00	+ 18·05	570·41	566·63	568·33	—	567·48	+3·78	+2·08	—	+2·93
.... f Mount Tourget.........	5746·22 5665·38	− 3·05	+ 5·03	+0·20	+ 83·02	653·43	649·96	652·69	659·85	654·17	+3·47	+0·74	− 6·42	−0·74

Mount Tourget......... t, inn, White Cross......	5865·38 5785·94	+ 2·60	+ 7·60	+0·30	− 131·06	522·37	518·63	524·59	528·12	523·78	+3·74	−2·21	− 5·75	−1·41
inn, White Cross...... ating point, road to Moy-	5783·46 5765·84	− 3·80	+ 0·76	0·00	+ 14·58	536·95	—	542·24	—	—	—	−5·29	—	—
.... of la Pyle on the Ain, netre above water.......	5765·84 5910·76	+ 9·25	+ 6·55	+0·40	+ 161·12	375·83	—	375·66	—	—	—	+0·17	—	—
of la Pyle on the Ain... Moyrans, near Citernon	5910·76 5744·03	− 2·90	+ 4·74	+0·50	+ 169·07	544·90	—	545·22	—	—	—	−0·32	—	—
.... ns, first floor of the Croix	5744·03 5669·93	+ 7·10	+ 2·01	+0·20	+ 83·41	628·31	—	622·77	—	—	—	+5·54	—	—
.... ating point, road to Villas	5663·14 5622·53	− 2·20	+ 2·13	0·00	+ 40·54	668·85	—	663·43	—	—	—	+5·42	—	—
.... the rock d'Antre, signal	5622·53 5338·86	0·00	+14·57	+0·90	+ 299·14	967·99	967·96	960·64	961·34	963·31	+0·03	+7·35	+ 6·65	+4·68
.... ating point, road to St. de........................	5339·44 5574·44	− 7·40	+11·95	+0·60	− 240·15	727·84	—	726·43	—	—	—	+1·41	—	—
.... of Prad, Court-yard...	5574·44 5608·70	+ 1·20	+ 2·06	0·00	− 37·52	690·32	—	688·56	—	—	—	+1·76	—	—
.... ude, 0·7 metres above the rs of the Bienne	5608·70 5886·93	+ 9·85	+12·97	+0·85	− 301·90	388·42	—	383·96	—	—	—	+4·46	—	—

Third Series, setting out as in the second from Lons-le-Saunier.

e-Saunier, 0·6 metres e ground .... n, road to Mirebel.	 6033·13 5786·54	+ 1·20	+19·04	+0·77	+ 267·60	268.56 535·56	529·10	532·32	—	530·71	+6·46	+3·24	—	+4·85
.... n Mirebel, signal of Del-	5786·54 5628·64	− 5·90	+10·79	+0·50	+ 163·29	698·85	692·14	694·26	717·46	701·28	+671	+4·59	−18·61	−2·43

The mean differences for the points marked in the last four columns of the table are,

Metres.	Metres.	Metres.	Metres.
4·27	3·84	8·01	2·25

And in eliminating for Paris the last result, the difference of which is − 18·61, evidently suspicious, we shall have for this point 2·14.

These results will be the more surprising, because the mean disagreements are inversely as the horizontal distances; because these distances are very great; and because the successive observations are made at too great intervals from each other, are too few, are made at times when the atmospherical disturbances are great, and because they are almost always solitary. Certainly all these causes united might have occasioned enormous errors, and yet the agreement of the results does not allow us to suspect their existence. Of how much importance would such measurements be to general geology if they were made to traverse whole continents.

To point out the more clearly the advantages and the accuracy of the barometer, I shall exhibit in the following table the series of disagreements which affect the most accurate geodesical measurements which have been executed in Europe since the introduction of the circle of Borda, and the improvement of the geometrical methods by Delambre. Surely no one will be tempted to blame such observers, and to say that they were not capable of doing better. If the great mathematicians who measured the meridian of France, if we ourselves have not been able to obtain better results, the reason is, that the nature of the problem does not admit of a greater degree of exactness. It would be in vain to endeavour to come nearer the truth by multiplying zenith distances, and then making a choice *à posteriori* to get the results to agree. Such a method would be contrary to all the principles of probability. It would be disagreeable to every honest observer, and ought to be severely and absolutely banished from geodesy. It may indeed flatter the pretensions of those who would be thought to do better than any one else; but it will never impose upon philosophers.

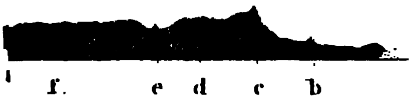
Measure of the meridian by Delambre and Mechain.								Unpublished triangulation by ...... with reciprocal zenith distances not simultaneous.		Unpublished triangulation by .... with reciprocal zenith distances not simultaneous.			Measurement of the Syrian mountains by M. Rebout, with a single zenith distance and hypothetical refraction.	
North part by Delambre, with reciprocal zenith distances not simultaneous.				South part by Mechain, with ditto.		By a single zenith distance, with hypothetical refraction, by Delambre and Mechain.								
Metres.	Metres.	Metres.	Metres.	Metres.	Metres.	Metres.	Metres.	Metres.	Metres.	Metres.	Metres.	Metres.	Metres.	Metres.
2·60	0·43	0·06	2·53	1·95	2·81	7·80	0·19	3·74	5·19	6·53	3·45	10·16	91·60	23·39
1·23	0·57	0·62	1·85	3·23	0·27	5·85	0·58	4·13	0·12	0·18	4·14	6·29	0·00	23·39
1·36	7·29	4·72	2·70	4·87	1·60	21·44	1·95	1·00	5·21	11·00	6·25	6·53	1·94	62·37
0·68	8·08	0·49	6·20	5·65	1·04	91·60	1·95	4·04	3·23	0·47	6·75	2·30	27·29	21·44
1·94	3·55	3·98	3·98	5·81	6·24	9·75	1·95	3·52	1·34	0·49	2·11	5·83	13·64	83·81
4·60	0·30	1·27	1·87	2·64	1·72	21·44	13·64	2·06	1·93	6·31	2·54	23·42	77·96	33·13
3·52	6·90	9·57	1·48	6·01	0·64	0·00	3·20	1·47	2·56	2·79	2·64	14·45	17·54	
10·59	0·40	9·74	2·50	6·46	1·20	17·54	5·65	2·16	3·68	2·86	3·46	6·82	44·83	
8·89	0·70	4·90	5·65	7·60	5·85	3·90	6·00	3·28	2·70	4·69	6·01	3·47	111·09	
7·25	1·77	5·10	1·17	4·54		9·75	6·47	2·93	6·20	1·40	1·60		21·44	
0·88	1·07	2·30	3·33	1·95		13·64	60·17	2·68	2·00	3·16	0·09		50·67	
4·41	2·16	0·14	2·11	11·50		7·80	64·74	1·79	1·90	8·20	4·56		19·49	
1·75	2·05	0·00	3·63	0·60		13·64	4·54	2·62	0·80	5·44	1·08		23·39	
0·27	2·15	1·83	0·80	0·80		11·69	11·00	1·81	0·20	0·35	0·26		31·88	
2·92	0·45	5·00	4·52	0·08		3·90	35·68	1·04	0·40	2·01	8·79		19·49	
6·47	1·75	7·96	22·90	1·24		11·69	4·87	1·41	2·10	22·33	1·50		17·54	
0·41	3·70	3·35	3·67	6·60		3·90	3·90	2·51	0·70	3·74	0·74		87·71	
3·61	1·56	13·30	11·54	4·58		3·90	14·54	4·34	2·00	2·69	9·37		83·80	
0·21	8·40	1·75	20·10	3·84		1·95	43·43	6·15	2·80	2·15	11·08		35·08	
0·14	0·82	1·30		3·96		0·58	2·30	6·60	8·20	1·66	4·86		46·78	
						0·20		6·20						
Mean = $\left(\frac{297\cdot74}{79}\right)$ = 3·77 metres.				Mean = $\left(\frac{105\cdot28}{29}\right)$ = 3·63 metres.		Mean = $\left(\frac{548\cdot71}{41}\right)$ = 13·38 metres.		Mean = $\left(\frac{119\cdot74}{41}\right)$ = 2·92 metres.		Mean = $\left(\frac{249}{49}\right)$ = 5·08 met.			Mean = $\left(\frac{1070\cdot01}{26}\right)$ = 41·16 metres.	

These mean limits of disagreement, compared with my measurement of the profile of Jura, appear to me to establish a weight of probability in favour of barometrical measurements. It is true that my measurement is only a peculiar case which cannot constitute a rule. But I can assure the reader that I have calculated a great many of my observations, and that they have not only been almost all equal, but often superior in accuracy. This will appear as soon as I make known my other determinations.

The limits 13·38 metres and 41·16 metres given by those measurements in which only a single zenith distance was employed, and in which it was necessary to introduce a hypothetical refraction, show evidently that this method is inferior to barometrical measurements, and of course not to be tolerated at present. The coefficient of the refraction is a quantity so variable and so vague, that I cannot express a sufficient degree of astonishment that a constant value is employed for it, applicable in all circumstances and seasons. Each mathematician gives his own according to his ideas and his experiments. I have also attempted to form one; and after having combined a great number of good zenith distances, I have satisfied myself that there is nothing constant in the coefficient but its inconstancy. I have seen it vary between 0·06 and 0·21 of the terrestrial arc. The different times of the day and the changes of the seasons occasion this enormous difference. I believe that sufficient attention has not been paid to the influence of the time of day. In general all the atmospherical phenomena are modified by horary circumstances. The barometer, the thermometer, the hygrometer, the electrometer, the magnetic needle, all point out horary anomalies. The same hours, producing nearly the same effects, ought to occasion the same ordinary terrestrial refraction. This I had an opportunity of recognising on our base of Ensisheim, in Alsace. This line of 20,000 metres cuts a horizontal plane without obstacle. As a small movement on the surface of the earth prevented us from discerning the signals, we caused a trench to be cut in their direction; notwithstanding this, I could not observe the southern signal from the north end; yet it was raised about 20 metres above the ground. An enormous poplar grew near it, and made it more easily be discerned. During the hours about noon I neither could perceive the one nor the other. About three o'clock I began to discover the top of the poplar above the horizon; some time after, the black ball, constituting the top of the signal, began to appear. I was then able to make my angular observations. I carefully watched this phenomenon, and I always saw the signal reach the same position at the same hours. After three o'clock, the time of the appearance of its summit, it became gradually more and more elevated, showing me first its ball, then its whole pyramid of 20 metres of elevation, then its foot, and at last, a little before ne o

ura

e scale as the distances.



ders   Alluvial Sand

Ensisheim in Alsace with pieces of Platinum

Towards Evening

the time when it ceased to be visible, it appeared under the form of a very obtuse pyramid upon the top of an apparent hill, produced by the effect of refraction upon the plain, the refracted points of which, in consequence of their distance, exhibiting to me an inclined plane imitating upon the horizon the projection of a hill. The poplar, whose enormous pyramid rose to the height of 28 metres, appeared to me then reduced to a spherical mass of three or four metres in height; and if we recollect that the contour of the line to which I referred these appearances was itself elevated by refraction in proportion to its distance, we shall have an idea of the differences of terrestrial refraction at different times of the day. I give here four figures representing in the opening of the objective of my telescope the profile of the trench and the different aspects of the signal and poplar in its neighbourhood at the four principal epochs. (Plate LXXXVI.)

I conceive, from a great deal of experience, that the refractions in the same season are nearly horary. Hence it would be of great importance for geodesy to determine the horary values of the coefficient. We might then hope to obtain good vertical measurements by means of zenith distances. Till this great and useful undertaking be accomplished, I can recommend to geographers a method which has succeeded with myself, and which I regret that I did not think of sooner. It is founded on the coincidence of hours. To determine the difference in the height of two points, I observe them reciprocally at the same hours, though on different days. This expedient is not rigorously exact; but I am persuaded that it has the advantage of eliminating, in the same season, the principal error. It may be employed by a single observer, as is often necessary in practice. By adopting this method, so simple and so easy, which neither requires more means nor more calculations, and which spares the time that would be uselessly wasted on taking repeated zenith distances, I believe with confidence that we should be able to reduce the limits of disagreement to small fractions of a metre. I intend to employ this method in the new geodesical operations with which I am going to be charged; and I expect from it the most complete success.

It has been proposed to determine the circumstantial coefficient by observing the zenith distance of a point whose height is already known; but this supposes the refraction to remain constant during the intervals of the observations; and, likewise, that the trajectories of the rays coming from all the points of the horizon are similar curves, modified in proportion to the distances; but all these suppositions are gratuitous, and contrary both to theory and experiment. The method which I propose has not the same inconvenience. The luminous ray passing through the same space undergoes very probably the same modifications, especially if the barometrical pressures and the temperatures are nearly the same, which we may ascertain for our greater satisfaction.

A similar undertaking remains to be executed for the formula for barometrical measurement. This last is affected likewise by horary influences. All the observers, and particularly M. Ramond in his celebrated and useful researches, have pointed out this effect. It is the coefficient for noon which has been generally adopted and applied to all the hours of the day; for noon would limit the barometrical method too much. We must employ the whole day if we wish to obtain series of points, profiles, &c. Let me then request zealous observers employed in elevated situations, geodesically connected, to collect the data requisite for the solution of this interesting problem. I am at this moment employed in calculating a series of 112 corresponding observations made with great care at two points, the difference of whose heights has been trigonometrically determined. These observations were made at intervals of two hours, from eight o'clock in the morning till six in the evening. If I succeed in discovering any pretty constant law, I shall communicate it to the public. But it ought not to be concealed that the determination of such laws ought to be the result of an immense number of observations collected in all seasons, made in all hours, and varied in many different places, and with different horizontal and vertical distances.

Paris, Feb. 15, 1818. DELCROS.

Appendix by the Editors of the Bibliotheque Universelle.

It may be worth while to quote, in support of our correspondent's ideas, the opinion of a celebrated philosopher on the comparison of the measurements of heights by the two methods of trigonometry and the barometer. This opinion is found in the memoirs of M. le B. Ramond "Sur le Nivellement Barometrique des Monts Dores et des Monts Domes," presented to the Academy of Sciences in 1815, in which he announces having determined the absolute height of about 400 remarkable points in the most interesting part of the department of the Puy-de-Dome, and indeed of the whole of France. For this region, which corresponds to the mean parallel of our hemisphere, is likewise the portion of the realm where the mountains are most elevated, and the levels the most different and best characterized, by the very different nature of the beds, mostly volcanic, but belonging to epochs separated by very long intervals of time. He has examined how the inhabitants, spontaneous vegetation, and culture, are distributed on a vertical scale of 1900 metres, between the 45th and 46th degrees of latitude. Called as he has been more than once in the series of his operations to compare his barometrical data with the geodesical results obtained by zenith distances, observed by skilful mathematicians furnished with repeating circles, he finds sometimes discordance between the two methods, and great probability in favour of the first; sometimes agreement; and in that case a prodigious advantage in facility and dispatch on the side of the barometer; "and the accuracy of the trigonometrical method," he observes, "has likewise its bounds. When we compare together the total and partial measures which it has furnished us, we are forced to acknowledge that none can be depended on nearer than one or two metres. This uncertainty indeed is but small; but that which attends barometrical measurements is not greater; and if we employ separately the different series which have concurred to the determination of the mean angle, these exhibit disagreements which far exceed the limits within which the errors of the barometer are confined."

"The imperfection of the two methods comes from a common source; and the two instruments are equally defective when the disposition of the atmospherical strata is such that the gradual decrement of heat and humidity is altered or inverted. But this disorder exhibiting itself to the trigonometrical instruments by anomalies in the refraction, appears to exercise on the results an incomparably greater effect than when it alters the ratio of the pressures indicated by the two corresponding barometers. In this last case, a small number of observations is sufficient to compensate for the errors; but in the first case a very considerable number are requisite: and M. Broussaud and myself have convinced ourselves that barometrical measurements taken with care are preferable to trigonometrical measurements themselves, whenever these last do not repose on reciprocal and very numerous observations, made with excellent instruments and by very skilful persons, with all the conveniences and all the time requisite for such operations."

Explanation of the Profile of Jura in Plate LXXXVI. *Places denoted by the Letters.*

a, Geneva.
b, Gex.
c, Mount Colombier.
d, La Faucille.
e, Valley of Mijoux.
f, Culminating point; *vallon tourbeaux*.
g, Sept-Moncel.
h, Highest point of the road.
i, St. Claude.
k, Bienne (river).
l, Chateau de Prax.
m, Roche d'Antre; signal.
n, Moyrans.

o, Road near Citernon.
p, Bridge de la Pyle on the Ain.
q, Highest part of the road.
r, Orgelet.
s, Mount Tourget.
t, Highest point of the road.
u, Ditto.
v, Lons-le-Saunier.
x, Plateau Calcaire.
y, Chateau Mirebel (signal).

A B, Syphon barometer, constructed at Berne, in 1811, by Noseda, a pupil of Paul, of Geneva; and employed in 1811 and 1812 in the barometrical measurements executed by M. Delcros in Alsace and in Switzerland.

G D, Profile of the tube without the mounting.

Article VI.

Remarkable Atmospheric Phenomena and their Effects.

By Dr. William Burney.

Gosport Observatory, Sept. 24, 1813.

Since the commencement of autumn, considerable changes have taken place in the atmosphere from a dry to a humid and electric state, and the temperature has consequently been very much diminished.

On the 1st inst. we had a storm of rain, hail, thunder, and lightning; the latter continued very strong and vivid from two till half-past four, a. m. while the thunder proceeded in a north-west direction. On the 5th, 1·33 inch of rain fell, which is as much as had fallen here during the preceding 16 weeks.

16th.—At a quarter before eight, p. m. a large lunar iris appeared on an extensive *Nimbus* to the west, the harvest moon being in the east, nearly full, and about 10° above the horizon; in 15 seconds after, it was well formed by refraction and the reflection of the lunar rays through the falling drops of rain, the moon was eclipsed by a dark passing cloud, and the phenomenon disappeared instantaneously. There was no time to measure it, but the semicircle appeared nearly as large as the solar rainbow under-mentioned.

21st and 23rd.—We had strong equinoctial gales rising from the south and south-west soon after sun-rise, and dying away at sun-set.

A solar halo appeared on light vesicular vapour on the 1st, 6th, 14th, and 22nd, and a lunar halo in the evening of the 17th; three of them were 44°, and two 45° in horizontal diameter, their perpendicular diameters being somewhat greater; and they were all followed by rain, in some instances in less than four hours after disappearing.

On the 23d, from 40′ till 55′ after five, p.m., a double solar rainbow appeared to the east, when the sun was within two or three degrees of the western horizon, and measured as follows:

Diameter of the exterior semicircle.	84°	30′	00″
Distance of the interior from the exterior bow at the north side.	8	22	30
Distance of ditto from ditto at the south side..	8	22	30
Greatest diameter of the exterior semicircle....	101	15	00

This measurement of the rainbow is as wide as it can be within 9′, according to the most accurate calculation; it was of longer duration, and the finest in colours that I ever remember to have seen; and the sun was so favourably situated as to make it the largest in extent.

Sept. 25.—Fine coloured *parhelia* appeared this morning at intervals from 50 minutes past seven till five minutes past eight o'clock, on an attenuated *Cirrostratus* cloud from the southward. At eight, the sun's altitude from the horizon was 19° 4′ 40″, and each parhelion was 23° 30′ distant from, and parallel with, the real sun, making their altitudes equal with the luminary, and the halo in which they were situated, and which was very conspicuous, 47° in horizontal diameter. Each parhelion disappeared three times, and their formation on re-appearing was more simple than that of the *parhelia* which I attempted to describe in page 235 of the last number of the *Annals*: the colours, however, were similar, but the mock-suns smaller, viz. a little larger than the apparent size of the sun's disc.

State of the Wind, Clouds, and Instruments, at Eight o'Clock.—Wind, due south. Attenuated *Cirrostratus*, gradually increasing in extent and density, through which the sun shone faintly, and some *Cirrus* in the zenith. Height of the barometer 29·60 inches, and of the thermometer 55°. De Luc's whalebone hygrometer 75°, there having been a copious deposition of dew upon this instrument till after sun-rise. These, as well as the last *parhelia*, were followed by a sinking barometer; the sky was overcast by two, p.m. and rain came on at four.

26.—About eight minutes before eight, a.m. *three* coloured *parhelia* appeared on a thin *Cirrostratus* that was passing very slowly in a north-west direction from this place; the sun's altitude at the same time being 18° above the horizon, and the halo, in which the parhelia were situated, 45° 10′ in horizontal diameter to the outside of the colours.

The two *parhelia* parallel with the sun, were each 22° 35′, and the upper parhelion nearly 23° distant from the centre of his disc; the latter was formed by the intersection of part of another halo at the top of the perfect one, and the parhelion at the point of this intersection was the largest and the most resplendent in prismatic colours. The three *parhelia* thus situated in the upper semicircle of the perfect halo, formed, with the sun, two right angles.

The state of the instruments was nearly the same as at eight o'clock yesterday morning, and very heavy showers of rain fell during the afternoon. Hence it may be concluded that both solar and lunar halos are certain signs of a humid atmosphere and of approaching rain.

The rains this month, amounting to upwards of four inches, have penetrated the dusty surface to a good depth, and have had beneficial effects on the vegetable tribes: the loamy meadows too, which three weeks ago were completely scorched by the hot sunshine, so that scarcely a blade of grass could be seen, are now overspread with a lively verdure, having the appearance of spring.

Remarks on the Weather that preceded and followed two other Mock-Suns, seen at Gosport Observatory.

Oct. 2.—At eight, p. m. a very brilliant meteor fell through a space of about 25°; it was of the apparent size of Jupiter, towards which planet it proceeded in its descent from the zenith, with astonishing velocity.

5.—At one, a. m. several loud claps of thunder, and lightning, accompanied by heavy rain, and strong gusts of wind at intervals, driving the clouds upon each other.

6.—At seven, p. m. a small whitish meteor, which emerged from behind a *Cirrostratus* cloud to the S.W.: at 10, the sky cleared up, by a change of wind from W. to N.W.

7.—A copious dew (which, with a temperature of 40°, penetrated through the glass windows), that had been deposited on the grass before sun-rise, was converted into fine hoar-frost for the first time this autumn. In a few minutes after sun-rise, a *Stratus* arose in the adjoining meadows, perhaps from the exhalation of the heavy dew. When the sun had ascended a few degrees, a parhelion appeared in the eastern point of the compass, 23° distant from, and parallel with, his disc; a broad streak of *Cirrostratus* crossed the sun at the time, and reached near the mock-sun, which was adorned with the usual prismatic colours. Barometer 29·75 inches, thermometer 45°, hygrometer 80°, and the wind due north. A sunny day, with ramified, linear, and plumose *Cirri* from the N.W., forming into extended arcs as they passed off by the force of an upper current from that quarter, it being calm below; these *Cirri* were succeeded by fleecy and dusky *Cumuli*, some of them very lofty; also *Cumulostratus*, which, on coming to the zenith, passed to a *Nimbus*, and a short *shower followed*: after 10, p. m. the sky became apparently clear.

8.—Heavy dew and hoar-frost as the preceding morning: at six, a. m. a dense *Cirrostratus* formed a fog-bank on Portsdown-hill, about four miles distant; and on its arriving here at eight o'clock, the hygrometer, which before stood at 75°, went to 80°, notwithstanding a brisk northerly wind: a clear atmosphere the remainder of the morning. P. M. Fleecy and dusky *Cumuli*, which, being to the westward, at sun-set passed through orange, dark blue, lake, and crimson tints, while the eastern sky exhibited a rose colour; the arched part of it was about 35° in height, with a purple base: this magnificent appearance of the evening *Crepusculum*, which remained in view an hour after sun-set, was evidently produced by reflection from haze descending rapidly in that quarter, the dew having fallen here copiously soon afterwards: an apparent clear sky through the night.

9.—Very heavy dew and hoar-frost as the preceding morning; also a dense *Stratus* resting on the ground, and large *Cirri* and *Cirrocumuli* descending into the lower atmosphere. At 10 minutes before eight, a. m. another parhelion appeared 23° 30′ to the east of, and parallel with, the sun, on an attenuated *Cirrostratus* that was passing slowly in an easterly direction: the south end of this modification did not extend more than 10° beyond the real sun, nor was there any solar halo to be seen; but a faint one appeared at noon. Hence a parhelion with its natural colours may appear without a solar halo when a cloud is thus situated between the sun and the observer, or when there is not enough vesicular vapour on either side of the sun to create a mock-sun; and on the other hand, a solar halo 45°, 46°, or 47° in diameter may frequently be seen in a vaporous atmosphere without a parhelion, or *parhelia*.

Faint sunshine through attenuated and undulated *Cirrostratus*, and some distant *Cumuli* near the horizon till five, p. m. when the wind veered from N.W. to S.W., and the night turned out wet.

The two subsequent days and nights were very wet, mostly drizzling, till the evening of the latter day (the 11th), when a strong gale with heavy rain came on from the S.W. and closed this change of weather; and the barometer is now rising to its former level.

Errata.

In the middle of p. 235, the article *a* before beautifully coloured *parhelia* is superfluous; and in the second line below, *for* equidistant from, *read* equidistant 23° 30′ from.

Article VII.

On Stimulants and Sedatives. By Dr. Wilson Philip.

(To Dr. Thomson.)

DEAR SIR, *Worcester, Sept. 26, 1818.*

In compliance with your request, I trouble you with a few observations in illustration of the following remarks in the 254th page of the second edition of my Inquiry into the Laws of the Vital Functions; namely, "A moderate application of every agent appears to act as a stimulus; and excessive application of it as a sedative. The quantities which act as stimulus and sedative bear no particular proportion to each other, but in different agents exist in every possible proportion."

It appears on the most cursory view of the phenomena of life that they depend on a capacity of action in living parts and the operation of agents capable of exciting them. Thus the heart possesses the power of contraction, but it soon becomes inactive if the blood is withdrawn. The degree of excitement produced is proportioned to the force and continuance of the exciting cause and degree of excitability possessed by the part acted on. By the action of the stimulus, the excitability is always impaired, and by its continued action at length exhausted. Thus excitement continues, unless the agent is withdrawn, till the part is so far deprived of its excitability that it will no longer obey the same degree of the same agent. To produce further excitement a more powerful agent must be applied, or the excitability of the part acted on must be increased.

The excitability is, within certain limits, increased by the abstraction of agents. Thus, for example, our sensibility, one species of excitability, is exhausted by the various agents which affect us during the day; and we find by degrees that the same agents no longer excite us. If more powerful agents are not applied, we soon fall into a state of insensibility, sleep, during which the operation of the usual agents being withdrawn, we again become sensible to these agents.

Such are the more evident laws of excitability; and it would be easy, I think, to prove that they are the laws which regulate the cerebral system in a state of health. But it has been maintained that the same laws regulate the excitability of every part of the animal. To this position a very obvious objection occurs.

When the eye becomes wearied with seeing, the ear with hearing, &c. they cease to be excited; their excitability is thus allowed to accumulate, and they are again fitted for their functions: they are not concerned in the preservation of life. An animal may be in perfect vigour, as far as relates to the powers on which his existence depends, although he neither sees nor hears. The vital powers remaining in sleep restore vigour to the exhausted organs of sense; but were the vital organs themselves subject to similar exhaustion, what during such intervals would preserve the life of the animal? and by what powers would the vigour of these organs be restored?

It has been said, indeed, that the diastole of the heart arises from the stimulus of the blood exhausting its excitability in the systole which is restored to it during the interval that elapses between its contraction and the occurrence of that degree of distention which again excites it. But a very simple experiment shows the fallacy of this opinion.

If the heart is exhausted by the stimulus of the blood, and recovers its excitability during the absence of such a quantity of this fluid as is capable of exciting it, it ought not to recover its excitability if it is prevented from expelling any part of the blood which has excited it; for we have seen that the continued application of the same stimulus which has produced exhaustion cannot again excite the exhausted part, as no renewal of excitability can take place while the agent which exhausted it is still applied. The retina will never recover its powers under the impression of the same degree of light which exhausted it. We cannot recover from fatigue while the cause of our fatigue still operates. But the alternate contractions and relaxations of the heart still take place, as I have ascertained by repeated experiment, although a ligature be thrown around the aorta, in consequence of which, the heart remains uniformly gorged with blood. The result of this experiment is not influenced by previously destroying the sensibility of the animal by a blow on the occiput.

If we sprinkle salt on a muscle, it does not occasion permanent contraction followed by exhaustion, but a constant alternation of contraction and relaxation, although the salt is never removed. The state of the muscle, however, in the relaxations which intervened between the contractions is evidently very different from that in which it is left when the salt can no longer excite any contraction in it.

The foregoing facts seem to prove that the nervous and muscular excitability obey different laws. While the effect of uniform stimuli acting on the former is permanent excitement, followed by exhaustion, the habit of the muscular fibre under the influence of uniform stimuli is to act by intervals. This is probably the cause why moderate excitement seems not to exhaust the muscular fibre, while the nervous fibre suffers proportional exhaustion from every degree of excitement.

Two circumstances appear to be capable of occasionally counteracting this habit and producing in the muscular fibre permanent contraction, a peculiarly strong stimulus and the influence of the will. It is only, however, occasionally that the most powerful stimuli have this effect; and it is only for a limited time that the will can produce it. After a certain time, the natural tendency of the muscle to alternate contraction and relaxation prevails, and the limb which we wish to keep steady begins to tremble.

There is another species of debility of the living fibre of a very different nature from the exhaustion we have been considering, which appears to bear no relation to any previous excitement; but to be the direct effect of agents; for while some agents increase, others lessen, the action of this solid. The former have been called stimulants, the latter sedatives.

It has been maintained, indeed, that as exhaustion is the effect of moderate excitement, the species of debility we are now considering is always the consequence of excessive excitement; and, therefore, that, like exhaustion, the sedative effect is never the direct effect of the agent. And this opinion seems at first view to be countenanced by the fact that stimuli act as sedatives when applied in excess. Thus a moderate quantity of distilled spirits received into the stomach produces excitement, which, within certain limits, is greater in proportion to the quantity taken; but if a very large quantity be suddenly received into the stomach, it produces no degree of excitement, but immediate debility, or even death.

It is surely a strained explanation of the latter effects, however, to suppose them the consequence of excessive excitement, no symptom of which appears. The supposed existence of this excitement rests wholly on the preconceived opinion, that exhaustion, in consequence of previous excitement, is the only debility which can arise from the operation of agents on the living fibre. It has, therefore, been maintained, that however imperceptible the excitement produced by large quantities of distilled spirits for example, we must suppose that their first effect is excitement, and their debilitating effect, consequently, only secondary. And so much has this idea laid hold of the minds of many, that in an account of the above Inquiry, lately published in a journal of great respectability, my opinion of the nature of inflammation is opposed on the ground that the operation of agents in producing this disease must, in the first instance, be stimulant; and the debility of the vessels, which it is admitted exists in inflamed parts, the consequence of previous excitement; and this is maintained without questioning the accuracy of my experiments, from which it appears, that none of this previous excitement could be perceived with the aid of powerful microscopes. Now I may surely be allowed to maintain that where no increased action can be perceived, none should be supposed. We must not substitute hypothesis for plain matter of fact.

But if this argument, which is of all the most conclusive, were out of the question, there is another, which, as far as I can judge, would be unanswerable, to which even the supporters of the hypothesis in question must listen. It must be admitted, even by them, that if the tendency of different agents to produce debility arises from the degree of excitement occasioned by their first impression on the living solid, those best calculated to produce excitement should be found capable of the greatest sedative effect. But this is so far from being true, that we find that the agents which produce the greatest degree of this effect are the worst stimuli. Tobacco, for example, which is one of the most powerful sedatives, cannot, by any management, be made to produce the degree of excitement which arises from opium or distilled spirits.

The sedative, like the stimulant effect, may be communicated to the muscular through the nervous system. When tobacco is applied to any considerable part either of the brain or spinal marrow, as I have ascertained by repeated experiment, the heart soon begins to act more languidly; but this languor is preceded by little, if any, increased action, unless the tobacco be applied in a very diluted state; in which case, it produces comparatively little languor, and the excitement is much less than that produced by opium, which is followed by no sensible languor.

If we disregard preconceived opinions and fix our attention on facts alone, we shall, as far as I am capable of judging, arrive at the following conclusions. Every agent capable of affecting the living solid acts both as a stimulus and sedative according to the degree in which it is applied. Applied within certain limits, it is a stimulus; and in proportion as it stimulates, it exhausts the excitability, this being equally true of the interrupted excitement which stimuli produce in the muscular, as of the permanent excitement which they produce in the nervous system. Applied beyond these limits, agents no longer produce excitement followed by proportional exhaustion, but direct exhaustion arising from the operation of the agent, and wholly unconnected with previous excitement, the stimulant and sedative powers existing in no particular proportion to each other, but in different agents in every possible proportion. I have just had occasion to mention the comparative effects of tobacco and opium in the heart. Thus the stimulant power of distilled spirits is great, its sedative power small. It must be used in very great quantity to produce the sedative effect; while a small quantity of digitalis produces this effect, and its stimulant power is very slight.

These observations apply to agents affecting the mind as well as the body. Grief and fear possess great sedative power; they act as stimulants only when they are present in a comparatively small degree. Joy and anger, on the other hand, are powerful stimuli, and only act as sedatives when in excess. There is no exception, I believe, to the law we are considering. There is no agent which may not be made to produce a stimulant effect by applying it in very small quantity, and none which does not act as a sedative when applied in excess. I remain, dear Sir,

Your faithful humble servant,

A. P. W. PHILIP.

ARTICLE VIII.

On the Annual Fall of Rain at Glasgow.

By Thomas Thomson, M.D. F.R.S.

It is a general opinion that the quantity of rain which falls at Glasgow is greater than the fall at Edinburgh; but this opinion does not seem founded upon any well-authenticated documents. It is probable that it rains more frequently at Glasgow than at Edinburgh; at least this is the general opinion, and is not denied by the inhabitants of Glasgow themselves. But to judge from the registers kept at Glasgow and near Edinburgh, the quantity of rain which falls in the neighbourhood of the former city is rather less than what falls in the neighbourhood of the latter. We are in possession, indeed, of no regular table of the weather at Edinburgh; but a rain gauge has been long kept by the Duke of Buccleugh at Dalkeith Palace, within six miles of Edinburgh; and the annual depth of rain which falls at this place is regularly published. Now this is uniformly greater than the fall of rain at Glasgow. Indeed when the situation of Glasgow is considered, one would expect less rain at it than at Edinburgh. It is nearly 20 miles inland from the west coast; and is, therefore, beyond the immediate influence of the Atlantic, which renders some parts of the north-west of England so rainy; while its distance from the east coast, and the high land between it and Edinburgh, screen it from those violent rains when the east wind blows, which are so common in Edinburgh. The distance of the hills from Glasgow is further than from Edinburgh; and it is in some degree screened by high grounds both on the east and the west.

The city of Glasgow lies in north latitude 55° 51′ 32″,* and in longitude 4° 16′ west from Greenwich. The surface of the Clyde at Glasgow at low water is probably elevated about 15 feet above the surface of the sea at Greenock; for the tide rises only a few feet at the new bridge, and it proceeds but a very little beyond Rutherglen bridge, which is scarcely the eastern boundary of this populous city. The College gate is elevated 60 feet above the Clyde; and the Macfarlane observatory, situated in the College garden, must be very nearly at the same elevation. A rain guage, constructed by Crichton, was placed upon the top of this observatory in the year 1801; and a regular register has been kept of the rain ever since by the Professor of Astronomy. This rain gauge is elevated about 20 feet above the surface of the garden, or 80 feet above the Clyde. It is situated on a plain, at some distance from any houses, and not overlooked by any trees. The situation, therefore, with the exception of its height above the river, is as favourable for accurate observations as can be. It deserves to be mentioned that the rain guage at Dalkeith

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* Edinburgh is in north latitude 55° 56′ 42″. It is, therefore, 5′ 10″ further north than Glasgow, which is very nearly six miles.

Palace, and the one at Sir Thomas Brisbane's, at Largs, upon the west coast, are all exactly similar, and were all made by Crichton; so that they can be accurately compared with each other. Dalkeith Palace stands, I conceive, at a greater height above the river Esk than the Macfarlane observatory does above the Clyde. The following table exhibits the fall of rain at Glasgow for the last 17 years. It was kindly drawn up at my request by Dr. Couper, Professor of Astronomy.

Register of Rain at the Macfarlane Observatory.

	1801.	1802.	1803.	1804.	1805.	1806.	1807.	1808.	1809.
	Inches.								
Jan....		1·627	0·426	3·881	1·483	2·329	0·908	1·246	1·485
Feb....		1·645	1·544	0·545	1·617	1·579	0·959	0·778	2·820
March..		0·927	0·752	2·310	2·130	0·272	0·288	0·082	0·360
April..		1·450	1·051	0·791	0·630	0·683	1·085	1·525	0·336
May...		0·606	1·286	2·406	0·885	2·085	2·430	1·371	2·379
June...		1·500	1·229	1·150	1·023	0·737	0·995	1·814	2·479
July...		3·802	0·800	1·587	1·414	2·693	3·205	3·178	2·245
August.		2·000	2·111	3·676	1·778	2·869	3·415	5·597	5·233
Sept....	2·015	1·200	1·900	0·771	2·030	1·497	2·746	0·616	2·325
Oct....	2·912	2·851	0·595	2·527	0·015	2·254	3·644	2·171	1·442
Nov....	0·993	0·679	1·540	1·937	0·309	3·506	1·553	2·135	0·925
Dec....	1·347	1·470	1·234	0·701	2·468	3 358	1·016	1·342	3·158
Total. .		19·757	14·468	22·282	15·782	23·862	22·244	21·795	25·182

	1810.	1811.	1812.	1813.	1814.	1815.	1816.	1817.	1818.
	Inches.								
Jan....	1·743	1·723	1·352	1·242	0·032	1·135	1·342	2·624	2·594
Feb....	1·283	2·735	1·424	2·746	0·826	2·312	1·514	3·103	2·163
March..	1·687	1·254	1·865	1·342	0·702	2·457	1·126	0·627	1·952
April..	0·659	2·054	0·842	0·216	1·654	0·925	1·243	0·072	1·420
May ...	0·510	2·783	1·443	2·133	0·625	2·104	1·715	1·990	1·912
June...	1·145	1·982	1·802	0·794	0·127	1·246	1·584	2·312	0·904
July ...	3·124	1·635	1·531	2·342	2·478	1·531	4·312	1·773	4·963
August.	2·874	3·545	2·166	1·307	2·397	2·354	2·146	2·854	0·310
Sept....	0·724	1·273	2·342	1·563	0·384	2·275	3·214	0·629	
Oct. ...	1·176	2·854	5·345	2·385	3·145	2·402	2·446	0·892	
Nov....	3·374	3·252	2·452	1·362	2·976	1·823	1·014	2·546	
Dec....	2·584	2·711	0·246	0·936	4·176	1·780	2·143	3·058	
Total. .	21·433	27·801	22·810	18·868	19·522	22·344	23·799	22·420	

The following table of the fall of rain at Corbeth, 12 miles north-west from Glasgow, near the Campsie hills, and at the height of 466¼ feet above the level of the Clyde at Glasgow, will give the reader an idea of the great increase of rain as we advance nearer the west coast and the mountains. It was kept by Mr. Guthrie, of Corbeth; and the rain gauge is precisely the same as that used at the observatory of Glasgow.

1815	41·393 inches.
1816	39·589
1817	44·965

Article IX.

Analyses of Books.

Transactions of the Royal Society of Edinburgh, Vol. VIII. Part II. 1818.

This part contains the following papers:

I. *On the Effects of Compression and Dilatation in altering the Polarizing Structure of Doubly Refracting Crystals.* By David Brewster, LL.D. F.R.S. Lond. and Edin.—Dr. Brewster shows that when pressure is applied to a thin plate of calcareous spar bounded by planes perpendicular to the axis of double refraction (the shorter diagonal of the crystal), the circular rings of colour formerly observed change their shape. A similar effect is produced upon quartz, and indeed upon all doubly refracting crystals, whether *negative* or *positive*. He shows very ingeniously that this alteration is not owing to a modification of the original force, but to the creation of a new force. Hence it is easy to determine *à priori* the effect of compression or dilatation upon doubly refracting crystals. When positive crystals are compressed parallel to the axis of the crystal, the tints *rise*; when the axis of compression is perpendicular to the axis of the crystal the tints *descend*. When the same crystals are dilated, the opposite effect takes place. If the crystals be negative, compression in the direction of the axis makes the tints *descend*; perpendicular to the axis, it makes them *rise*. By dilatation, *vice versâ*.

II. *Experiments on Muriatic Acid Gas, with Observations on its Chemical Constitution, and on some other Subjects of Chemical Theory.* By John Murray, M.D. F.R.S.E. This paper will be printed in a future number of the *Annals*.

III. *Experiments on the Relation between Muriatic Acid and Chlorine; to which is subjoined the Description of a new Instrument for the Analysis of Gases by Explosion.* By Andrew Ure, M.D. Professor of the Andersonian Institution, and Member of the Geological Society.

It has been demonstrated by decisive experiments, and is universally admitted, that when chlorine and hydrogen gases are mixed together in equal volumes, and an electrical spark is passed through the mixture, these two gases disappear, and there is found in place of them a quantity of dry muriatic acid exactly equal in volume to the two gases before the combustion. Two explanations of this fact have been advanced. Gay-Lussac and Thenard, who, as far as I know, were the first chemists that established the fact by rigid experiments, explained it in this way. Chlorine gas is a compound of one volume of muriatic acid and half a volume of oxygen condensed into one volume. The volume of hydrogen combines during the combustion with the half volume of oxygen, and forms water. This water unites with the muriatic acid, which is incapable of existing without it in the gaseous state, and of course of being separated from it without depriving this acid of its gaseous state; and according to their calculations, the water which thus constitutes an essential part of muriatic acid amounts to about $\frac{1}{4}$th of the weight of the compound. According to this explanation, chlorine is a compound of one atom of oxygen and a certain unknown substance which has never yet been obtained in a separate state. If we add an atom of hydrogen to this compound, it unites with the atom of oxygen, is converted into water, and this water combining with the unknown basis, converts it into muriatic acid gas. Sir Humphry Davy explained the fact in another and a much simpler manner. According to him, chlorine is a *simple* (that is to say, an *undecompounded*) body. An atom of it has the property of combining by combustion with an atom of hydrogen, and of forming muriatic acid. Gay-Lussac and Thenard have adopted this explanation, and abandoned their own. Indeed they suggested it in their original publication; and Gay-Lussac informs us that he had embraced it from the first, and that he had always from that time taught it in his lectures.

According to the first of these explanations muriatic acid is a compound of $\frac{1}{4}$th water and $\frac{3}{4}$ths of an unknown substance, which constitutes the acid of the muriates: according to the second it is a compound of chlorine and hydrogen.

Dr. Murray, of Edinburgh, is almost the only person in this country who has supported the *first* or *old* opinion. A controversy took place several years ago in Nicholson's Journal, between him and Dr. John Davy, on this subject; the former supporting the old, the latter the new opinion. This controversy was carried on by both with much ability, and led to the discovery of a variety of new and interesting facts; but it terminated as almost all controversies do: both combatants retained the original opinions with which they had set out, and both of them boasted of having gained a complete victory, and of having established his own opinions by the most satisfactory arguments.

It occurred to Dr. Murray that *muriate of ammonia* might be employed to furnish an evidence on the one side or the other which should be decisive. According to the old view of the subject muriatic acid contains $\frac{1}{4}$th of its weight of water: when it unites to ammonia this water ceases to be necessary to its constitution, and may, therefore, be obtained in a separate state. Suppose we mix equal volumes of dry muriatic acid and ammoniacal gases, they combine and constitute sal-ammoniac. Now a volume of ammonia approaches to half the weight of a volume of muriatic acid; therefore, dry sal-ammoniac, formed by the union of the gases, must contain about the 6th of its weight of water; therefore, 100 grains of sal-ammoniac made in this way, if the old theory be true, must contain nearly 17 grains of water. Dr. Murray formed sal-ammoniac by uniting the gases; he exposed it to heat, and he obtained, in every case, a sensible *quantity of water*: this result, in his opinion, decided the con troversy in his favour. As sal-ammoniac when prepared from the dry gases always exhibits traces of water, it follows, he conceives, that this water must have existed in combination with the muriatic acid; therefore, &c.

But this mode of reasoning did not satisfy his adversaries. The quantity of water thus evolved they said was small, and it became less and less according to the care taken to have moisture more completely excluded. They ascribed the water which made its appearance to the aqueous vapour which always exists in gaseous bodies, and from which, perhaps, it is impossible to free them.

Dr. Ure is one of those persons who seems to have thought well of the opinion which Dr. Murray defended, but not of the experiments by which he supported it. The object of the present paper is to bring forward unequivocal evidence of the existence of water as a constituent of sal-ammoniac and of muriatic acid; and to infer from this that the old opinion is the true one.

He sublimed sal-ammoniac very slowly through clean metallic filings (silver, copper, and iron) previously heated to redness in a glass tube. In every experiment, when properly conducted, there was a deposition of liquid in the part of the tube beyond the metals: this liquid was water of ammonia. The water which appears in this case he concludes must have previously existed in the sal-ammoniac; for as that salt contains no oxygen, it is plain that no water could have been formed by the decomposition of the salt. The old opinion, therefore, that muriatic acid gas contains water as an essential constituent, he considers as established by his experiments. These experiments appear to have been made with much care, and I have no doubt that the results are as Dr. Ure states them. I do not, however, see any reason for considering these experiments as decisive of the question, or as more favourable to the old opinion than the new. A short explanation will enable the reader to perceive the reasons on which this opinion is founded.

1. Muriatic acid seems capable of combining with most of the salifiable bases while in a liquid state, and of forming compounds to which the term *muriates* may be applied. Some of these compounds may be even exhibited in a solid state without decomposition. Now the salifiable bases (with an exception of two) contain oxygen, and muriatic acid contains hydrogen. Of course the constituents of water exist in all the muriates. Now whenever a muriate is subjected to a red heat it undergoes decomposition: the hydrogen and oxygen unite, and fly off in the state of water; while the chlorine combines with the reduced salifiable base, and forms a *chloride.* Thus when muriate of barytes is exposed to a red heat it is converted into chloride of barium, muriate of manganese into chloride of manganese, and so on.

2. When muriatic acid comes in contact with a salifiable base at a red heat, the very same double decomposition takes place; the *chlorine* unites to the reduced salifiable base, and forms a *chloride*; while the oxgyen of the one unites with the hydrogen

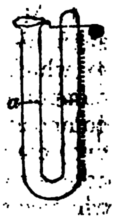
of the other, and flies off in the state of water. Accordingly it has been ascertained by experiment, that when muriatic acid gas is made to pass through red hot lime, barytes, strontian, &c. chloride of calcium, barium, strontium, &c. is formed, and a considerable quantity of water is evolved.

3. In Dr. Ure's experiments it is obvious that the sal-ammoniac was partly *decomposed;* for the liquid obtained was water of ammonia; therefore, the experiments are quite the same as if muriatic acid gas had been passed slowly through a glass tube heated to redness.

4. But a glass tube contains several salifiable bases; namely, oxide of lead, oxide of manganese, soda, &c. These will be partially converted into *chlorides* at a red heat, and of course water will be *formed.* Sir H. Davy has ascertained by experiment that this actually happens: he obtained water by passing muriatic acid gas through red hot glass tubes. Here then we see the source of the water in Dr. Ure's experiments, without being under the necessity of considering it as previously existing in sal-ammoniac.

The same explanation will apply to the water which made its appearance when Dr. Ure substituted muriatic acid gas for sal-ammoniac in his experiments. Into that part of the paper, therefore, I need not enter.

I may here notice an illustration which Dr. Ure employs in his paper, and which is to be found likewise in Dr. Murray's paper, which will be printed in a future number of the *Annals;*—it is that sulphuric acid cannot exist without water. Now this is a mistake. I can procure sulphuric acid free from water, with great ease, and I exhibited it last winter in that state to the Chemical Class in the University of Glasgow. The mode of obtaining anhydrous sulphuric acid, and the account of its properties in that state, will be found in the Fifth Edition of my System of Chemistry, vol. ii. p. 105.



Dr. Ure's eudiometer for exploding combustible gases is ingenious. It will be understood from the figure in the margin. It consists of a glass tube, sealed at one end and open at the other, bent into a syphon shape, with the two legs of equal length. The shut end is graduated, and furnished with metallic wires in the usual way. The mixture of gas to be exploded is put into the graduated side; a portion of mercury is allowed to remain in the bend of the syphon, filling it for example to *a*. Between *a* and the open mouth the tube is filled with common air. When the gas is to be exploded, cover the open mouth of the syphon with the finger, and pass an electric spark. The common air acts as a recoil spring, and prevents the fracture of the tube.

IV. *On the Laws which regulate the Distribution of the polarizing Force in Plates, Tubes, and Cylinders of Glass that have received the polarizing Structure.* By Dr. Brewster.—The author's observations and experiments are of so miscellaneous a nature, that we could scarcely make them intelligible to our readers by abridgment: we must, therefore, refer them to the paper itself. It is terminated by the description of an instrument for measuring the elasticity of bodies, to which Dr. Brewster has given the name of *teinometer*.

V. *Remarks illustrative of the Scope and Influence of the philosophical Writings of Lord Bacon.* By Macvey Napier, Esq. F.R.S. Lond. and Edin. and F.A.S. Edin.. Bacon is universally admitted to have first pointed out the importance of induction in advancing the sciences, and to have laid down the laws according to which inductive philosophy is to be cultivated. For many years this method has been generally adopted, and the progress of the sciences has accordingly been vast, and is still continuing. It has been generally admitted that the commencement of this great career was entirely owing to Bacon, and that he of consequence may be considered as in some measure the author of all the discoveries in science that have been made since his time. But there are some individuals who are of a contrary opinion. According to them, Bacon's writings had little effect, and indeed continued almost unknown till the sciences had made very considerable progress. The object of this very entertaining and judicious paper is to show that this latter opinion is erroneous; that Bacon's writings produced a great and immediate effect both in Britain and on the Continent; that both Newton and Boyle regulated themselves by his views, and that they led to the establishment of the Royal Society, to which the physical sciences lie under such obligation for their progress. These important points are established by an induction of particulars, which produces conviction, and which furnishes a good example of that Baconian logic, the value of which it is our author's object to establish.

It is not easy for us at present to estimate the exact effects of the Novum Organum; but that they must have been great, is, I think, undoubtedly true. In the present advanced state of the sciences, however, I conceive that the young philosopher may employ his time better than in studying the rules of Bacon's logic. The inductive method is much more easily acquired by example than by precept. Let him select the best examples of true inductive reasoning which are to be found, Newton's Optics and Principia for example, and let him study these so thoroughly as to imbibe their true spirit. He will be better qualified to advance the progress of any of the sciences than by a life-time devoted to the perusal of Bacon. Among the men of science in this country who have devoted considerable talents and much industry to the prosecution of scientific investigations with very little benefit either to themselves or others, were I to be asked to point out who have been most conspicuous, I should without hesitation select those who have professed the greatest admiration of the Baconian logic.

VI. *Sketch of the Geology of the Environs of Nice.* By Tho. Allan, Esq. F.R.S. Edin.

From this paper it appears that the country in the immediate neighbourhood of Nice is composed of limestone. Mr. Allan distinguishes two different formations, which he calls first and second limestone: the first he suspects to be transition, and the second to be floetz, but he did not verify his suspicions by satisfactory evidence. The first limestone has a brown colour, a compact texture, a conchoidal fracture, and, in general, shows no appearance of crystallization, though sometimes it does. It contains petrefactions, shells of different species, as cornu-ammonis, pecten, and corraloids. Flint also occurs in it in nodules, and seems sometimes to be in regular beds, as in chalk. Several varieties of this limestone are described. The second limestone, it would appear from the map which accompanies the paper, lies chiefly in the valleys skirting the different rivulets. It has the aspect, according to Mr. Allan, of having been *tumbled down* from above the first limestone; it lies in the most irregular state, and is distinguished by those contortions and involutions which have been so often described by the Huttonians with so much delight. Had they examined the loose sand on the north side of Edinburgh, they would have seen as many contortions in it as in the rocks of St. Abbshead themselves.

The second limestone is composed of strata varying very much in thickness from a few inches to several feet; its colour varies from bluish to brownish grey; sometimes it is hard and close grained, with a splintery fracture; sometimes its texture is earthy, and it gives an argillaceous smell. It contains a profusion of shells.

Besides these two formations, there is a vast deposite of alluvial gravel on the west side of Nice, and in other places in the neighbourhood. This gravel consists of fragments of primitive rocks, and contains mixed with it a vast quantity of shells, many of them the very same species that still exist in the Mediterranean.

The paper concludes with a catalogue of the shells found by Mr. Allan near Nice: they amount to 225 species. This catalogue is drawn up by Capt. Brown, who ascertained the names of the species; and there are 33 species which he considers as new. Of these he has given figures.

VII. *On certain Impressions of Cold transmitted from the higher Atmosphere, with the Description of an Instrument adapted to measure them.* By John Leslie, F.R.S.E. and Professor of Mathematics in the University of Edinburgh.

Mr. Leslie is the philosopher to whom we are indebted for almost all our knowledge of the *radiation* of heat. He himself, however, has never admitted the truth of the opinion that heat radiates. According to him heat is nothing else than *light* fixed in bodies; it never can leave a body at all without losing the *character of heat,* and assuming that of light. What others consider as radiation, he affirms to be nothing more than pulses of the air, similar to the undulations by which sound is propagated; these undulations may be either of *heat* or of *cold*, according as they proceed from a heated or a cooled surface. Accordingly, the amount of these pulses, or what is called the radiation of heat, differs according to the gas through which the pulsation takes place. In hydrogen gas it is much greater than in air, and in a complete vacuum it would disappear altogether. Nothing can be more ingenious than his views on this subject, nor than the instrument which he has contrived for measuring the pulses of cold emitted from a clear sky. But as, after reading over his paper with some attention, I have not been able to see clearly the evidence on which his opinions are founded, I think that the best way to do justice both to Mr. Leslie and to the readers of the *Annals* will be to print his paper. It will appear, therefore, in an early number.

VIII. *A Method of determining the Time with Accuracy, from a Series of Altitudes of the Sun, taken on the same Side of the Meridian.* By Major-General Sir Thomas Brisbane, Knt. F.R.S.E.

Sir Thomas Brisbane having been moving much about for a number of years, was unable to carry with him large astronomical instruments; he was induced in consequence to try how good results he could obtain from small instruments. His success has been such as to induce him to recommend the sextant as an instrument which would be much more employed by astronomers if its value were known. In this paper he shows his method of determining the time from a series of altitudes of the sun on the same side of the meridian. This method he recommends as fully as exact as the method by equal altitudes, and as more exact than that method when a change of temperature has taken place in the interval between the forenoon and afternoon observations. For the method itself we must refer to the paper, as it could not be made intelligible without transcribing the whole calculation.

IX. *Observations on the Junction of the Fresh Water of Rivers with the Salt Water of the Sea.* By the Rev. John Fleming, D.D. F.R.S. Edin. As the specific gravity of salt water is greater than that of fresh, Dr. Fleming naturally conjectured that when the tide begins to flow up the mouth of a river, the salt water will occupy the bottom of the channel, and will be covered by the fresh water which will occupy the surface. A set of trials made on the waters of the Frith of Tay at different times of the tide, fully confirmed the accuracy of his opinion. Mr. Stevenson made similar observations on the waters of the Don, but he found this not quite the case with the Thames. From his trials on that river he was led to infer that the fresh water moves backwards and forwards without any real flow into the sea.

X. *Memoir of the Life and Writings of the Hon. Alexander*

Frazer Tytler, Lord Woodhouselee. By the Rev. Arch. Alison, L.L.B. F.R.S. Lond. and Edin. We shall insert this very interesting memoir in our next number.

ARTICLE X.

SCIENTIFIC INTELLIGENCE, AND NOTICES OF SUBJECTS CONNECTED WITH SCIENCE.

I. *Academy of Natural Sciences in Philadelphia.*

A number of individuals in Philadelphia have for some years been accustomed to meet at leisure hours for the purpose of communicating to each other such facts and observations as were calculated to promote the knowledge of the natural sciences among themselves, and of extending it among their fellow citizens. On April 25, 1817, they were by the legislature of Pennsylvania incorporated into a society under the title of the Academy of Natural Sciences of Philadelphia. They have made some progress in the formation of a museum and a library; and since the time of their incorporation, they have begun to publish a Journal in the octavo form. By Jan. 1, 1818, eight numbers were published, making in all 218 pages. The first four numbers consist of a sheet each; the next three of two sheets; and the eighth, which is the last number that I have yet seen, consists of three sheets and $\frac{7}{8}$ of a sheet; but of it $1\frac{1}{8}$ sheets are filled with the act of incorporation, the constitution of the society, and a catalogue of the books and museum belonging to them.

This Academy cannot but greatly promote the advancement of all the branches of natural history by making us better acquainted than we have hitherto been with the natural productions of the vast continent of America. To give my readers some idea of the subjects treated of in the Journal of this Academy, I shall transcribe the contents of the numbers published during the year 1817.

1. Description of six new Species of the Genus Firola, observed by Messrs. Le Sueur and Peron in the Mediterranean Sea in the Months of March and April, 1809. By C. A. Le Sueur.

2. Account of a North American Quadruped, supposed to belong to the Genus Ovis. By George Ord.

3. Description of seven Species of American Fresh Water and Land Shells, not noticed in the Systems. By Thomas Say.

4. Descriptions of several new Species of North American Insects. By Thomas Say.

5. Observations on the Genus Eriogonum and the Natural Order Polygoneæ of Jussieu. By Thomas Nutall.

6. Notice of the late Dr. Waterhouse.

7. Characters of a new Genus, and Descriptions of three new Species upon which it is formed; discovered in the Atlantic Ocean, in the Months of March and April, 1816; lat. 22° 9′. By C. A. Le Sueur.

8. Description of three new Species of the Genus Raja. By C. A. Le Sueur.

9. Some Account of the Insect known by the Name of Hessian Fly, and of a parasitic Insect that feeds on it. By Thomas Say.

10. On a new Genus of the Crustacea, and the Species on which it is established. By Thomas Say.

11. An Account of an American Species of the Genus Tantalus, or Ibis. By George Ord.

12. An Account of the Crustacea of the United States. By Thomas Say.

13. A short Description of five (supposed) new Species of the Genus Muræna, discovered by Mr. Le Sueur in the Year 1816. By C. A. Le Sueur.

14. Description of two new Species of the Genus Gadus. By Mr. Le Sueur.

15. Description of a new Species of the Genus Cyprinus. By Mr. Le Sueur.

16. An Account of an American Species of Tortoise, not noticed in the Systems. By C. A. Le Sueur.

17. A new Genus of Fishes of the Order Abdominales, proposed, under the Name of Catastomus; and the Characters of this Genus, with those of its Species, indicated. By C. A. Le Seur.

18. An Account of two new Genera of Plants, and of a Species of Tillæa and Limosella, recently discovered on the Banks of the Delaware, in the Vicinity of Philadelphia. By Thomas Nutall.

19. Description of new Species of Land and Fresh Water Shells of the United States. By Thomas Say.

20. Descriptions of four new Species, and two Varieties, of the Genus Hydrargira. By C. A. Le Sueur.

21. Observations on the Geology of the West India Islands, from Barbadoes to Santa Cruz, inclusive. By William Maclure.

22. Observations on several Species of the Genus Actinia; illustrated by Figures. By C. A. Le Sueur.

23. Description of Collinsia, a new Genus of Plants. By Thomas Nutall.

24. Act of Incorporation; Constitution of the Society; Library; Donors to ditto; Donations to Museum; Apparatus.

II. *Common Magnesia Alba of the Shops.*

Berzelius informs us that he has ascertained the common magnesia alba of the shops to be a compound of three atoms of carbonate of magnesia and one atom of hydrate of magnesia.—(Ann. de Chim. et Phys. vii. 206.) Grotthuss has expressed a suspicion that common magnesia may be a compound of carbonate and hydrate of magnesia—(Schweigger's Jour. xx. 276); a suspicion which seems to have been verified by Berzelius about the time that it was made; for though Berzelius's statement was not published till some months after Grotthuss's conjecture, there is every probability that his experiments had been completed before the publication of Grotthuss's paper. Bucholz informs us that magnesia alba exists in three different states of combination.

These observations of Berzelius and Grotthuss may, perhaps, apply correctly to the magnesia alba exposed for sale in the apothecaries' shops of Sweden and Germany. In these countries, the chemical medicines exposed to sale are subjected to an annual examination. Hence it is natural to look for more uniformity in their state than in this country where no such examination takes place, and where every chemical manufacturer is left entirely to his own judgment. I have had occasion to examine a good many specimens of magnesia alba purchased in druggists' shops, and I have found too great a diversity in its composition to permit the conclusion that it is a chemical compound. It seems rather to be a mechanical mixture of carbonate of magnesia, caustic magnesia, and, perhaps, hydrated magnesia, in different proportions. This no doubt would depend upon the state of the alkali employed to throw it down from Epsom salt, or muriate of magnesia; for it is from these two salts that it is usually procured. I shall give, as an example, an analysis of a magnesia alba, purchased in Glasgow, which I made last winter.

Carbonic acid.	14·0	1 atom
Magnesia	51·4	4 atoms
Water.	28·0	5 atoms
Sulphate of lime.	6·6	
	100·0	

III. *Discovery of Haüyne in the Island of Tyree.*

M. Necker, of Geneva, some time ago, discovered haüyne in the primitive limestone of the island of Tyree. The following is the account of the specimens which he observed, as stated by him in a letter to Professor Jameson:—

Colour.—Sky blue, pure, and sometimes a little greenish.
Lustre.—Vitreous, shining.
Transparency.—Pellucid.
Fracture.—Vitreous.
Hardness.—Scratches glass.
Chemical Characters.—With the blow-pipe does not melt, but loses its colour and becomes opaque.

By the acids it is dissolved; the quantity was too small to ascertain whether it formed a jelly.

Occurs disseminated in grains not exceeding a line in diameter, in nodules composed of feldspath, mica, and sahlite, which are found in the limestone rocks on the sea shore, west of the farm of Balapheitrich, near the quarry of primitive limestone in the island of Tyree. The specimen of these nodules which I have brought home with me from that spot being small, and the haüyne not abundant, and in very small grains, I was very limited in my experiments upon this interesting substance here, for the first time I believe, found elsewhere than in volcanic rocks. I trust that by your exertions, and those of future travellers in the western islands, more will be known of this mineral. To promote such an inquiry, you may, if you think it proper, insert this in some of your scientific journals. I think I have mentioned the place where I found it in a manner clear enough to guide the mineralogist who may chance to visit the island of Tyree. It is on the rocks near the high water mark, exactly due west of the farm house of Balapheitrich, in round nodules projecting from the surface of the limestone strata.

Believe me, my dear Sir, your obedient humble servant,

L. A. Necker, Prof.

IV. *Tungstate of Lime.*

This rare mineral, the nature of which was first ascertained by Scheele, was some years ago subjected to a rigid analysis by Berzelius. He found it a compound of

Tungstic acid	80·417	100·00
Lime	19·400	24·12

As it is a neutral salt, there can be no doubt that it is a compound of one atom tungstic acid and one atom lime. Hence if an atom of lime weigh 3·625, an atom of tungstic acid must weigh 15.

Professor Bucholz and Mr. Rudolph Brandes, without being aware of what had been done by Berzelius, have lately subjected two varieties of this mineral to a very careful analysis. It is an object of some consequence to compare the results which they obtained with those of Berzelius, that we may see how far they confirm his conclusions. I shall, therefore, state here the composition of the two minerals according to their analyses.

The first variety had a yellowish white colour, and a specific gravity of 6·076. It was from Schiackenwald. Its constituents were

Tungstic acid	78
Lime	$19\frac{2}{33}$
Silica	2
	$99\frac{2}{33}$

The second variety was from Zinnwald; its colour was brown, and its specific gravity 5·959. Its constituents were,

Tungstic acid	$76\frac{1}{2}$
Lime	$16\frac{1}{2}$
Silica	$2\frac{16}{17}$
Oxide of iron	$1\frac{8}{17}$
Alumina, with a trace of lime, $\frac{10}{17}$	$1\frac{3}{34}$
Pure alumina $\frac{1}{2}$	
	$98\frac{1}{2}$

If we compare these two analyses with each other, on the supposition that the silica, iron, and alumina, are merely mechanically mixed, we obtain the composition of tungstate of lime from the first analysis,

Tungstic acid	100·000
Lime	24·437

and from the second,

Tungstic acid	100·000
Lime	21·568

These two analyses do not very well accord with each other; but the reason seems to be partly owing to the whole of the lime not having been procured in a separate state in the second analysis. A portion of it remained mixed with the alumina. This puts it out of our power to employ the second analysis in our comparison with the experiments of Berzelius. But the first analysis corresponds very well with the results obtained by Berzelius. According to Berzelius's analysis, the weight of an atom of tungstic acid is 15·03. According to the first analysis of Bucholz and Brandes, its weight is 14·834. This differs considerably from 15, which results from the analysis of Berzelius, and shows us the difficulty which attends the accurate determination of the weights of the atoms of bodies.

V. *Magnetism.*

The very little progress which the theory of magnetism has yet made, and the little knowledge of the laws of the variation of the compass which has yet been acquired, are known to all my readers. This is probably the cause why magnetism has of late years been so much neglected in this country. I am induced, partly on this account, and partly in consequence of the great importance of the subject, to call the attention of literary men to a treatise on magnetism to be published about this time by M. Hansteen, Professor of Practical Mathematics in the Norwegian University of Christiania. It is to be entitled "Researches on the Magnetism of the Earth," and is to be divided into nine parts. I shall give for the satisfaction of my readers the titles of the different parts.

Part I. Of Halley's Lines of *Declination*, and of their Alteration from the Year 1600 to 1800.

Part II. Of the Lines of *Inclination* and their Magnetical Force.

Part III. Preliminary Estimate of the Number of Magnetic Poles of the Earth; their Position, and their Periodical Revolution round the Pole of the Earth.

Part IV. Calculation of Halley's Lines, according to the first imperfect Theory of Euler.

Part V. Mathematical Theory of Magnetism, with Experiments.

Part VI. Use of this Theory in the Theory of Magnetic Declination, Inclination, and Strengths.

Part VII. A more accurate Determination of the Position of the Magnetic Poles, of their Size, and of the Differences between their absolute Strength.

Part VIII. On the Diurnal Variation of the Needle.

Part IX. On the Magnetical Phenomena, accompanied with Light or the Aurora Borealis.

This book I presume will be written in the German language: at least I have seen it announced in the German periodical works.

VI. *Sand of the River Rhine.*

From the observations and experiments of Mr. Koelreuter, of Karlsruhe, we learn that the sand of the Rhine consists of the following substances:

1. Sandy red iron stone.
2. Chromiron.
3. Quartz sand.
4. Mica sand (very small in quantity).
5. Common fine foliated gold.

The chromiron, according to the analysis of Koelreuter, was composed of

Protoxide of iron	98
Oxide of chromium	2
	100

The foliated gold, being subjected to a chemical analysis, was found composed of the following constituents:

Gold	93·5
Silver	6·0
	99·5

The sandy red iron stone being analyzed, yielded the following constituents:

Oxide of iron	61
Silica	35
Oxide of manganese	2
Alumina	2
	100

(Schweigger's Journ. xxi. 121.)

VII. *North West Expedition.*

I have seen a letter from a gentleman on board Capt. Ross's vessel, at present employed in endeavouring to find a north west passage, dated July 25, 1818. At that time the ship was in north latitude 75° 45′, and in longitude 60° 30′ west from Greenwich. The coast was found generally 100 geographical miles further west than as laid down in the Admiralty charts. In Davis's Strait four different barriers of ice had been met with; one in lat. 68°; one in lat. 70°; one in 72° 40′; and one between 74° and 75°; this they were in hopes would prove the last. In lat. 75° 4′, the variation of the compass was 88° west. The temperature of the water at the depth of 200 fathoms was 29°; at the depth of 80 fathoms it was 30°, and at the surface 34°. The water was found deeper near the coast than at some distance from it. At three islands, described by Baffin, within half a gun shot of the shore, the depth was 160 fathoms; while 15 leagues off it was only 8·3 fathoms. Capt. Ross had invented a deep sea clamm, by which a portion of the ground could be brought up from a great depth. The crew were in excellent health and spirits.

VIII. *Zumic Acid.*

Some years ago Braconnot announced that when water containing oatmeal, rice, &c. was allowed to run into fermentation, a peculiar acid was formed, to which he gave the name of *nanceic* acid, from the town in which he happens to live. As this mode of naming bodies is never tolerated in chemistry, I gave it in the last edition of my System of Chemistry the name of *zumic* acid, and gave an account of its properties as they were ascertained by Braconnot. This acid has lately attracted the attention of Vogel; he has examined it when formed by the fermentation of different species of corn. He found it always the same acid when properly purified; and he assures us that it is nothing more than the *lactic acid* of Scheele and Berzelius. *Zumic* acid, therefore, supposing Vogel's statement to be correct, must be struck out of the list of acids.

IX. *Knebelite.*

This is a name given by Dobereiner to a mineral which was given him by Major Von Knebel, and which differs in its composition and characters from all other minerals hitherto observed. Nothing is stated respecting the place where this mineral was found; but its description, as drawn up by Mr. Lenz, is as follows:

Its principal colour is grey, but it is spotted smutty white, brownish red, brown, and green.

It is massive.

External surface, uneven, and full of holes.

Lustre, both external and internal, glistening.

Fracture, imperfect conchoidal.

Fragments indeterminate; sharp edged.

Opaque, hard, brittle, difficulty frangible. Sp. gravity, 3·714.

Infusible by itself before the blow-pipe; but with borax it melts into a dark olive coloured bead.

Its constituents, according to the analysis of Dobereiner, are as follows:

Silica	32·5
Protoxide of iron	32·0
Protoxide of manganese	35·0
	99·5

or it consists of an atom of silicate of iron united to an atom of silicate of manganese.

Dobereiner is of opinion that if this mineral were to be found in abundance, it would yield at once, simply by reducing it to the metallic state, excellent steel. It is difficult to conceive on what this whimsical opinion is founded.—(Schweigger's Journal, xxi. 49.)

X. *Spodumene, or Triphane.*

This mineral, which was supposed confined to Sweden and Norway, where it was first observed, has been discovered lately in the Tyrol on the road to Sterzing, in a granite rock along with tourmaline. Its specific gravity is 3·1158, and it has not been found crystallized in this locality any more than in Sweden. It was analyzed by Vogel, and found composed of

Silica	63·50
Alumina	23·50
Lime	1·75
Potash	6·00
Oxide of iron	2·50
Water	2·00
Manganese	Trace
	99·25

Our readers are aware that the alkali to which the name of potash is given in this analysis is in reality *lithina*, which Arfvredson found in spodumene to the amount of eight per cent. It deserves inquiry, however, whether the new alkali be an *essential* constituent of this mineral. If it be only an accidental ingredient, it is very possible that the Tyrol spodumene may merely contain potash.

XI. *Tantalite.*

This mineral, hitherto confined to Sweden, has been lately found at Bodenmais, in Germany. Its specific gravity is 6·464. Leonhard and Vogel extracted from it by mechanical division a four-sided prism terminated by oblique faces, making angles of 94° and 86° with the sides of the prism. Vogel attempted to analyze it by the method followed by Berzelius, but could not succeed. He found its constituents as follows:

Oxide of tantalum	75
Protoxide of iron	17
Protoxide of manganese	5
Oxide of tin	1
	98

(Schweigger's Jour. xxi. 60.)

XII. *Action of Sulphur on the Muriates.*

Vogel has made a great number of experiments to ascertain what takes place when a mixture of a muriate and sulphur is exposed to heat. From these experiments he has drawn the following conclusions.

1. A great proportion of the metallic muriates are decomposed by sulphur.
2. The experiment does not succeed nearly so easily with the earthy and alkaline muriates as with the metalline muriates.
3. The following muriates were decomposed by means of sulphur:

Protomuriate of tin,
Muriate of copper,
Muriate of manganese,
Muriate of lead,
Muriate of antimony,
Protomuriate of mercury,
Permuriate of mercury.

4. During the decomposition of these muriates, sulphurous acid gas, and in some cases sulphuretted hydrogen, was evolved, and metallic sulphurets formed.
5. Muriate of iron and muriate of zinc, when treated in this way, would form no metallic sulphuret.
6. Muriates of potash, soda, and barytes, when heated to redness with sulphur, were very slightly decomposed.—(Schweigger's Journal, xxi. 62.)

XIII. *Separation of Magnesia from Lime.*

In analytical chemistry it is a problem of considerable importance to separate magnesia from lime when they happen to exist together in the same mineral; as, for example, in magnesian limestone. Many formulas have been proposed, but none of them has been found to answer completely. I may mention one or two of them by way of example. One of the oldest methods is to dissolve the two earths in an acid and to pour into the solution bicarbonate of potash. Lime does not readily form a bicarbonate, and the carbonate of lime is insoluble in water. Magnesia, on the contrary, enters easily into combination with two atoms of carbonic acid, and the bicarbonate is soluble in water. From these facts the conclusion was drawn that the lime would be totally precipitated while the whole of the magnesia would remain in solution. This method was examined by Bucholz with his usual precision; and he has shown that it does not answer.—(Schweigger's Jour. xvii. 56.) Dobereiner has proposed another which, in his opinion, answers perfectly. It is to dissolve the two earths in an acid, and to pour carbonate of ammonia into the solution. The lime will be precipitated in the state of a carbonate, but the magnesia forming a triple salt with the acid and the ammonia will remain in solution.—(Ibid. p. 78.) This method has been recently examined at great length by Professor Pfaff, of Kiel. The result of his experiments is, that, besides the lime, a portion of the magnesia is always precipitated by the carbonate of ammonia. He found further that when a solution of sal-ammoniac is boiled over a mixture of carbonates of lime and magnesia, the magnesia is not alone dissolved, but also a portion of the lime. This constituted a part of Dobereiner's method. Pfaff examined also the double salts which magnesia and ammonia form with the different acids; and he found that the proportion of these two bases differed materially according to the acid with which they were combined. In *sulphate* of magnesia and ammonia, in the *nitrate*, the *muriate*, and the *acetate* of these bases, he found the proportion of magnesia and ammonia to each other as follows:

	Magnesia.		Ammonia.
Sulphate.................	3	:	2
Nitrate..................	2	:	1
Muriate..................	1	:	1
Acetate..................	16	:	1

Pfaff considers the best method of separating lime from magnesia to be to dissolve both earths in an acid, to neutralize the solution, and then to precipitate the lime by means of oxalic acid.—(Schweigger's Jour. xxi. 74.) The method which I myself have been in the habit of employing for separating lime from magnesia has the advantage at least of being very easy; and though not absolutely precise, the error, I believe, when the experiment is rightly conducted, is very small. I dissolve the mixture of lime and magnesia in muriatic acid, or nitric acid; then add to the solution a quantity of sulphuric acid capable of saturating both the earths; I then evaporate the liquid to dryness, and expose the residual mass to a heat sufficient to expel the excess of acid, if any be present. The dry mass is digested in water, and a little alcohol is poured into the solution to diminish the solubility of the sulphate of lime. By this means I obtain the sulphate of magnesia in a state of solution, while the sulphate of lime remains behind in the state of a white powder. The only source of inaccuracy in this method is the solubility of sulphate of lime in water. An ounce troy of water dissolves about a grain of sulphate of lime; but more than two-thirds of this is thrown down again by the alcohol; so that three ounces of water, suppose such a quantity to be employed to dissolve the sulphate of magnesia, would dissolve about one gr. of dry sulphate of lime, which contains almost exactly 0·42 gr. of lime. The greatest error, therefore, which can be committed in this way cannot well exceed half a grain of lime. Even almost all this quantity of sulphate of lime might be recovered by repeatedly crystallizing the sulphate of magnesia; or still better, the lime might be separated from the solution of sulphate of magnesia by means of oxalic acid.

XIV. *Prehnite.*

Standish, Oct. 20, 1818.

I take the liberty of pointing out an error into which (in your *Annals* for Sept.) Mr. Finch has inadvertently fallen respecting the discovery of Prehnite at Pouck-hill, in Staffordshire. That gentleman very naturally states, that "prehnite has not been found before in England;" and he had good grounds for believing that to be the case; because the discovery of it in Gloucestershire two years ago has not, I believe, ever been made public.

In the autumn of 1816, Mr. Bakewell, who was giving lectures at Gloucester, &c. discovered very finely characterized prehnite in the trap-rock at Woodford, in the parish of Berkeley; specimens of which are in the possession of Dr. Jenner, and many other collectors in this neighbourhood.

ROBERT HALIFAX.

XV. *New Literary Institution, Cornwall.*

An institution has been established in Cornwall, denominated "*The Cornwall Literary and Philosophical Society,*" the principal object of which is the cultivation of the different branches of the mathematics, experimental philosophy, natural history, general history and biography, and the fine arts. Another object is the formation of a museum, towards which many liberal donations are stated to have been already made.

ARTICLE XI.

Magnetical, and Meteorological Observations.

By Col. Beaufoy, F.R.S.

Bushey Heath, near Stanmore.

Latitude 51° 37′ 42″ North. Longitude West in time 1′ 20·7″.

Magnetical Observations, 1818. — *Variation West.*

Month.	Morning Observ.					Noon Observ.					Evening Observ.				
	Hour.		Variation.			Hour.		Variation.			Hour.		Variation.		
Sept. 1	8h	40′	24°	36′	48″	1h	20′	24°	43′	56″	6h	55′	24°	38′	27″
2	8	25	24	37	56	1	25	24	46	59	6	55	24	31	46
3	8	25	24	34	54	1	30	24	44	40	6	45	24	38	48
4	8	25	24	33	42	1	25	24	47	55	6	45	24	41	15
5	8	25	24	34	58	—	—	—	—	—	—	—	—	—	—
6	8	30	24	34	04	1	25	24	46	20	6	35	24	35	48
7	8	35	24	33	48	1	20	24	45	51	—	—	—	—	—
8	8	35	24	33	42	1	25	24	45	48	—	—	—	—	—
9	8	35	24	36	07	1	20	24	44	22	6	35	24	34	47
10	8	25	24	34	02	—	—	—	—	—	6	35	24	36	55
11	8	30	24	35	56	1	25	24	45	43	—	—	—	—	—
12	8	25	24	34	46	1	20	24	45	56	6	20	24	36	04
13	8	25	24	34	18	1	25	24	44	06	6	20	24	35	25
14	8	20	24	34	44	1	20	24	45	06	6	15	24	35	27
15	8	25	24	34	38	—	—	—	—	—	—	—	—	—	—
16	8	20	24	33	20	1	25	24	45	04	6	15	24	37	43
17	8	30	24	41	06	1	25	24	46	22	6	20	24	35	49
18	8	25	24	35	47	—	—	—	—	—	6	15	24	36	26
19	8	25	24	38	12	1	20	24	47	10	6	15	24	37	05
20	8	35	24	50	00	1	20	24	48	29	6	10	24	40	49
21	8	20	24	40	56	1	20	24	47	10	6	10	24	38	47
22	8	25	24	36	25	1	20	24	43	51	6	05	24	39	29
23	8	25	24	33	45	1	20	24	42	41	—	—	—	—	—
24	8	20	24	33	24	1	25	24	41	37	6	05	24	37	53
25	8	25	24	34	25	1	20	24	41	28	—	—	—	—	—
26	8	35	24	34	42	1	25	24	46	39	6	00	24	36	01
27	8	25	24	45	24	1	35	24	47	56	—	—	—	—	—
28	8	25	24	35	00	1	15	24	46	11	6	00	24	35	32
29	8	20	24	34	15	1	20	24	46	45	6	00	24	37	23
30	—	—	—	—	—	1	20	24	44	47	6	00	24	36	34
Mean for the Month.	8	26	24	34	29	1	23	24	45	22	6	21	24	37	28

In taking the monthly mean of the observations, those on the morning and noon of the 20th are rejected, being so much in excess, for which there was no apparent cause. The evening ~~of the next day was stormy.~~

Meteorological Observations.

Month.	Time.	Barom.	Ther.	Hyg.	Wind.	Velocity.	Weather.	Six's.
Sept.		Inches.				Feet.		
1	Morn....	29·140	63°	45°	SE		Showery	58
	Noon....	29·133	68	35	SW	9·107	Cloudy	73½
	Even	29·125	64	40	SW by W		Cloudy	
2	Morn....	29·310	57	50	W		Fine	53
	Noon....	29·383	68	25	WSW	8·782	Fine	68½
	Even	29·445	61	33	SW		Fine	
3	Morn....	29·612	59	44	SSW		Cloudy	53½
	Noon....	29·626	67	32	SW by W	9·859	Cloudy	70
	Even	29·610	63	35	SSE		Rain	
4	Morn....	29·510	63	70	SW by S		Showery	60
	Noon....	29·515	70	45	SW by S	11·933	Showery	73½
	Even	29·553	67	49	SSW		Cloudy	
5	Morn....	29·558	64	86	SW by S		Sm. rain	63
	Noon....	29·538	—	77	SSW	—	Rain	66
	Even	29·432	—	79	S by W		Rain	
6	Morn....	29·300	56	70	W by N		Rain	54½
	Noon....	29·300	64	51	W	5·310	Cloudy	65½
	Even	29·300	62	45	W		Fine	
7	Morn....	29·405	56	52	NW		Very fine	56½
	Noon....	29·408	62	35	W by N	7·046	Fine	63½
	Even	—	—	—	—		—	
8	Morn....	29·462	53	54	Calm		Very fine	48½
	Noon....	29·467	60	40	NW	6·736	Cloudy	63
	Even	—	—	—	—		—	
9	Morn....	29·265	53	51	Var.		Fine	46
	Noon....	29·200	60	41	NE	1·806	Cloudy	60¼
	Even	29·195	51	49	NNE		Rain	
10	Morn....	29·308	49	54	N		Very fine	45
	Noon....	—	—	—	—	—	—	58½
	Even	29·360	51	38	NW		Very fine	
11	Morn....	29·400	48	52	WNW		Very fine	44½
	Noon....	29·405	57	34	Var.	6·528	Cloudy	59
	Even	—	—	—	—		—	
12	Morn....	29·555	51	52	NW		Fine	44½
	Noon....	29·555	60	36	NW	12·871	Fine	65
	Even	29·610	58	40	N by W		Cloudy	
13	Morn....	29·710	52	58	NNW		Fine	46½
	Noon....	29·770	63	44	N by W	4·239	Cloudy	65
	Even	29·810	57	47	N		Clear	
14	Morn....	29·795	51	57	WSW		Fine	48½
	Noon....	29·750	61	47	WSW	18·057	Cloudy	63½
	Even	29·660	61	52	WSW		Cloudy	
15	Morn....	29·405	59	53	W by S		Cloudy	52
	Noon....	29·250	—	70	SW	17·841	Rain	65
	Even	29·220	—	72	W by N		Rain	
16	Morn....	29·205	48	56	W		Fine	48
	Noon....	29·210	58	40	W by N	12·048	Cloudy	58½
	Even	29·205	53	50	SW		Fine	
17	Morn....	29·564	48	56	NW by W		Very fine	41½
	Noon....	29·663	52	50	NW	13·823	Showery	58
	Even	29·710	52	50	W		Fine	
18	Morn....	29·682	49	61	S		Rain	44½
	Noon....	29·605	—	90	SSW	—	Rain	56½
	Even	29·550	55	90	S by W		Cloudy	

Meteorological Observations continued

Month.	Time.	Barom.	Ther.	Hyg.	Wind.	Velocity.	Weather.	Six's.
Sept.		Inches.				Feet.		
19	Morn....	29·465	58°	83°	SSW		Cloudy	58°
	Noon....	29·403	62	66	SSW	12·448	Showery	68
	Even	29·360	59	60	SSW		Cloudy	55
20	Morn....	29·193	58	48	SE		Cloudy	
	Noon....	29·143	61	55	SSE	—	Showery	63½
	Even....	29·143	58	58	S by W		Cloudy	52½
21	Morn....	29·978	58	63	SE by E		Rain	
	Noon....	29·945	64	54	S by W	—	Showery	65½
	Even	29·058	58	49	SSW		Stormy	51⅓
22	Morn....	29·207	55	65	S by W		Cloudy	
	Noon....	29·222	62	43	SSW	6·505	Cloudy	62½
	Even	29·247	55	47	S		Fine	49
23	Morn....	29·233	53	59	SE by E		Fine	
	Noon....	29·165	61	48	S	11·267	Cloudy	64
	Even ...	—	—	—	—		Rain	54
24	Morn....	29·173	55	74	SSE		Cloudy	
	Noon....	29·193	62	43	SSW	8·744	Fine	63⅓
	Even	29·236	56	47	S by W		Fine	51½
25	Morn....	29·235	55	68	Calm		Fine	
	Noon....	29·228	62	47	Calm	—	Cloudy	63½
	Even	29·135	—	75	Calm		Rain	52
26	Morn....	29·077	51	76	WSW		Rain	
	Noon....	29·172	58	48	SW	10·861	Showery	60½
	Even....	29·205	53	66	S		Showery	48½
27	Morn....	29·165	52	73	SE		Fine	
	Noon....	29·155	59	55	SE	—	Showery	60
	Even....	29·127	—	64	SSE		Rain	52½
28	Morn....	29·216	59	62	ESE		Fine	
	Noon....	29·236	67	42	SE	8·325	Fine	68
	Even	29·240	62	55	E		Fine	56
29	Morn....	29 186	50	62	E		Cloudy	
	Noon....	29·200	66	49	E	8·849	Fine	67
	Even	29·200	63	60	E by S		Fine	56
30	Morn....	29 034	—	81	E		Rain	
	Noon....	29·032	63	54	SSW	10·632	Cloudy	63
	Even	29·047	59	64	ESE		Showery	

Rain, by the pluviameter, between noon the 1st of Sept. and noon on the 1st of Oct. 3·12 inches. Evaporation, during the same period, 3·40 inches.

ARTICLE XII.

METEOROLOGICAL TABLE.

1818.	Wind.	BAROMETER.			THERMOMETER.			Hygr. at 9 a. m.	Rain.	
		Max.	Min.	Med.	Max.	Min.	Med.			
9th Mon.										
Sept. 22	S E	29·70	29·65	29·675	69	48	58·5	80		☽
23	S E	29·65	29·53	29·590	61	53	57·0		20	
24	S E	29·68	29·60	29·640	64	48	56·0	75	—	
25	N E	29·65	29·33	29·490	65	51	58·0	66	1·22	
26	S W	29·66	29·50	29·580	61	45	53·0	98	20	
27	S E	29·65	29·52	29·585	64	54	59·0	100	—	
28	S E	29·66	29·59	29·625	73	55	64·0	85		
29	S E	29·61	29·41	29·510	68	54	61·0		—	
30	S E	29·47	29·40	29·435	63	51	57·0		25	○
10th Mon.										
Oct. 1	S E	29·60	29·40	29·500	66	45	55·5		—	
2	S E	29·65	29·50	29·575	68	51	59·5		—	
3	S W	29·51	29·40	29·455	66	52	59·0		90	
4	S W	29·50	29·36	29·430	66	47	56·5	61	15	
5	W	29·37	29·19	29·280	58	41	49·5	63	07	
6	W	29·50	29·25	29·375	60	32	46·0	64		
7	N W	29·79	29·50	29·645	59	32	45·5	82		☾
8	N W	29·88	29·79	29·835	57	34	45·5	89		
9	N W	29·85	29·64	29·745	60	46	53·0	78		
10	S W	29·64	29·48	29·560	63	51	57·0	71	13	
11	S W	29·71	29·40	29·555	65	46	55·5	78	23	
12	S W	29·91	29·71	29·810	61	44	52·5	65		
13	S W	29·98	29·86	29·920	66	47	56·5	71		
14	S E	29·99	29·91	29·950	70	52	61·0	74	—	●
15	S E	29·99	29·91	29·950	67	53	60·0	81	1	
16	S W	30·09	29·99	30·040	71	51	61·0	71		
17	N E	30·10	29·92	30·010	68	43	55·5	79		
18	Var.	29·99	29·92	29·955	63	47	55·0	76		
19	N W	30·06	29·94	30·000	63	49	56·0	75		
20	S E	30·20	30·06	30·130	61	31	46·0	71		
21	N E	30·20	29·98	30·090	56	44	50·0	72		
		30·20	29·19	29·698	73	31	55·31	76	3·36	

The observations in each line of the table apply to a period of twenty-four hours, beginning at 9 A. M. on the day indicated in the first column. A dash denotes, that the result is included in the next following observation.

REMARKS.

Ninth Month.—22. *Cumuli* beneath a canopy of haze, showing, as before rain, until evening, when the appearances gave place to *Cumulostratus* and red *Cirri*, followed by dispersion of the clouds, and fall of dew. 23. Much cloud, as yesterday, with wind: rain at dark. 24. Early morning, wet: then fair, with various clouds, threatening rain at intervals. 25. Dew: gray sky, with the lighter modifications: overcast, p.m.: rain, evening and night. 26. Morning, wet: windy, with *Cumulus*, *Cirrostratus*, &c.: a *Nimbus* in the S, p.m: rain after dark. 27. *Cumuli*, with an arch of *Cirrostratus* resting on their tops in the S: much dew: the dripping shrubs steam in the sunshine, and the breath is visible: *Cirri* in bundles succeeded at two different elevations, the lower pointing NW and SE, the higher NE and SW: heavy clouds next advanced from the S, the vane being at SE: a shower, by inosculation, about noon: drizzling, p.m. 28. Gray morning: a beautiful stratum of small *Cirrocumulus*, between *Cirrostratus* and *Cirrus*, at different considerable elevations: the *Cirrus* proved permanent, and the day was fine. 29. Very high coloured *Cirrocumulus* and *Cirrostratus* at sunrise: fine. 30. Wet morning.

Tenth Month.—4. Showers: evening, fine: windy. 5. Clear morning: showery day: wind high. 6. Foggy morning: clear day: a *Stratus* on the marshes at night. 7. Very foggy morning: white frost. 8. Foggy morning: fine, clear day. 9. Very foggy morning: cleared off about nine o'clock, a.m.: day fine. 10. Cloudy. 11. Cloudy, with slight showers: very boisterous night. 12. Morning calm and clear: day fine. 13. Fine day: a very distinct double lunar halo at night. 14. Fine day: clear moonlight. 17. Foggy morning. 21. Cloudy morning: very fine day.

RESULTS.

Prevailing Wind Southerly.

Barometer:	Greatest height	30·20 inches.
	Least	29·19
	Mean of the period	29·698
Thermometer:	Greatest height	73°
	Least	31
	Mean of the period	55·31
Mean of the Hygrometer		76
Rain		3·36 inches.

*** The whole of the observations, except of the barometer, from the 1st to the 21st inclusive, were made at the laboratory, Stratford.

Tottenham. L. HOWARD.

ANNALS

OF

PHILOSOPHY.

DECEMBER, 1818.

Article I.

Memoir of the Life and Writings of the Honourable Alexander Fraser Tytler, Lord Woodhouselee. By the Rev. Archibald Alison, LL.B. F.R.S Lond. and Edin.*

Alexander Tytler was born at Edinburgh, Oct. 15, 1747. He was the eldest son of our late venerable associate William Tytler, Esq. of Woodhouselee, in the county of Mid-Lothian, and of Anne Craig, daughter of James Craig, Esq. of Costerton, in the same county.

If the most important education is that which is received beneath the paternal roof,—if it is there that the principles and tastes of future life are chiefly formed, the education of Mr. Tytler began under fortunate auspices. His father was a man of high honour, of generous affections, of cultivated taste, and of distinguished eminence in his profession. His mother was a woman of elegant manners, of great gentleness and tenderness of disposition, and of still greater firmness of moral and religious principle. And the society in which they lived was nearly that of all those who then were distinguished in this city, by their manners, their talents, or their accomplishments. These advantages were not lost upon Mr. Tytler; and in this domestic school he early acquired that taste in life, or that sensibility to whatever is graceful or becoming in conduct or in manners, which ever afterwards distinguished him, and which forms, perhaps, the most important advantage that the young derive from an early acquaintance with good society.

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In the year 1755, he was sent by his father to the High School, then under the direction of Mr. Matheson. In that school he remained five years, distinguished to his school-fellows by the gaiety and playfulness of his manners, and to his teachers by his industry and ability; and when he left it he left it with the highest honours which the school can bestow, as Dux of the Rector's, or highest class.

The High School, however, although then a respectable seminary of education, had not yet acquired the eminence which it has since attained, by the zealous activity of the late Dr. Adam, and more recently by the enlightened improvements of the present rector, Mr. Pillans. To complete the classical education of his son, Mr. Tytler, therefore, determined to send him to one of the academies of England; and for this purpose he chose the academy at Kensington, then under the care of Mr. Elphinston, a man of learning and of worth, and distinguished by the friendship of Dr. Samuel Johnson. It was in the year 1763, when he was 15 years of age, that Mr. Tytler went to Kensington. He was himself at that time conscious of the imperfection of his classical knowledge; he felt that he had yet much to learn, particularly in the articles of prosody and of composition, and he entered the academy with the ambition of returning an accomplished scholar. The progress of youth and the instructions of his father had now awakened him to a sense of the beauties of classical composition; and the names of Johnstone and Buchanan reminded him that the accomplishments which he now travelled to acquire were once the produce of his own country.

With this ambition, he soon distinguished himself among his school-fellows of the academy. He became the favourite pupil of Mr. Elphinston, and received from that worthy man all that cordial assistance and encouragement which knowledge has so fortunate a pleasure in affording to the ardent and aspiring mind of youth. A little incident at this time too occurred which served to confirm Mr. Tytler in his love of Latin poetry, and in his ambition to excel in it.

The celebrated Dr. Jortin was at that period vicar of Kensington. Upon some occasion, when Mr. Tytler had particularly gratified Mr. Elphinston by a copy of Latin verses, the good man carried them in exultation to Dr. Jortin. The verses pleased Dr. Jortin so much that he requested to be made acquainted with the author. Mr. Tytler was accordingly introduced to him. He received him with the greatest kindness, and after praising the composition and encouraging his assiduity, he took down a copy of his own Latin poems, and requested Mr. Tytler to accept of it as a memorial of his approbation and regard. This volume, with a little inscription in the author's hand-writing, Mr. Tytler ever afterwards preserved with veneration, and often acknowledged that much of his attachment to Latin verse was owing to this little incident.

It is among the most important effects of these studies in early life, that they awaken the minds of the young to a new sense of the beauties of nature, and of the charms of poetical imitation. Both these effects Mr. Tytler seems at this period to have experienced. It was during his residence at Kensington that he first began the art of drawing and the study of landscape-painting; a pursuit which he continued ever afterwards to follow, and which formed one of the most favourite amusements of his future life. At the same time also, in his hours of leisure, he began by himself the study of the Italian language; and in the early admiration of the poetry of that country, with which his industry was then repaid, opened to himself a field of elegant and of refined amusement, which he never ceased to cultivate with increasing delight.

There was another acquisition which Mr. Tytler accidentally made at this time of which he always spoke with gratitude—it was the love of the science of natural history. When he went to Kensington he was particularly recommended by his father to his early friend Dr. Russell, the celebrated physician of Aleppo, who, at that time, resided in the neighbourhood of Kensington; and with this respectable and intelligent man Mr. Tytler used always to pass his holidays. Dr. Russell was then engaged in the pursuits of natural history; and seeing the ardour of his young friend for knowledge, he made him acquainted with the general principles of the science, associated him as his companion in study, and delighted him, in their leisure hours, by his accounts of the scenery and productions of the East. To these studies Mr. Tytler was then alone led by the charm which, in his eyes, they threw over nature, in the illustrations they every where afforded of the wisdom and benevolence of its author. He did not foresee that they were afterwards to become to him the source of unfading consolation, and to relieve many an oppressive hour of lassitude and pain.

In 1765 Mr. Tytler returned to Edinburgh, after two years passed at Kensington with equal happiness and improvement. Of these years he always spoke with pleasure, and of Mr. Elphinston with the most grateful and affectionate regard. He continued ever afterwards occasionally to correspond with him; and so little did the lapse of time, or the business of mature life, diminish the remembrance of early obligations, that when Mr. Elphinston died, he had the satisfaction of associating himself with his respectable widow in erecting, in the church-yard of Battersea, a monument to his memory.

In the close of the year 1765, Mr. Tytler entered the University of Edinburgh, and upon a new field of knowledge and of study.

The profession to which his own disposition and the wishes of his father inclined him was that of the law; the profession of all others connected with literature, most attractive to the ambition of a young man, both by the variety of powers which it demands and the importance of the distinctions to which it leads. It was to this end, accordingly, that his studies were now chiefly directed; and although he attended the lectures of Dr. Russell upon natural philosophy, and of Dr. Black upon chemistry, yet he seems to have limited himself to a general knowledge upon the subject of physical science, and to have reserved the vigour of his attention for those classes that more immediately related to his future profession. While he was pursuing, therefore, the study of civil law, under the tuition of Dr. Dick, and afterwards of municipal law, under that of Mr. Wallace, he followed with interest the useful and perspicuous prelections of Dr. Stevenson in the science of logic: he improved his taste by the celebrated lectures which Dr. Blair was then delivering upon the subject of rhetoric and belles lettres; and he listened with ardour to that memorable course of moral science in which Dr. Ferguson illustrated, with congenial power, the various systems of ancient philosophy, and occasionally exhibited all the splendours of ancient eloquence.

Of the progress, or success, of Mr. Tytler's studies during these years, no record, indeed, remains in the annals of the University. It has been the practice, and, perhaps, the wisdom of the Professors of that distinguished seminary, to seek more to gratify the desire of knowledge in the young by the instruction they convey, than to stimulate it by the distinctions they confer; and to look for their reward rather in the future eminence of those they instruct, than in the display of early and premature exertion. Of the dispositions or attainments of the young, however, there is at this age one unfading proof to be found in the character of the friends and associates whom they select. The circumstances of the times and the celebrity of the Professors had at this period excited in the young men of the University an unusual spirit of literary ambition; and many of those who have now arisen to the highest distinctions in their country were at this time laying the foundations of the eminence to which they have attained. It was in this class that Mr. Tytler sought for friends, and it was in this class he found them. The vivacity of his temper, the variety of his attainments, and the high spirit of honour which distinguished even his earliest years, rendered him acceptable to all the young and spirited of his own age; while his zeal for knowledge and his ambition of distinction conciliated the regard of those who were older. It was in these years, accordingly, that the great friendships of his life were formed; and it was his peculiar happiness that among those to whom the affections of his youth were given, the course of his mature life was passed, and its final period was closed. The list is an ample one, and will not be heard in this Society without emotion; for it contains the names of Henry Mackenzie, of Alexander Abercrombie (late Lord Abercrombie), of William Craig (late Lord Craig), of Allan Maconochie (late Lord Meadowbank), of William Adam (now Lord Chief-Commissioner), of Robert Liston, of Andrew Dalzel, of William Robertson (now Lord Robertson), of John Playfair, of Dr. Gregory, and of Dugald Stewart,—men, whom in this place it would ill become me to insult with praise, but from whose friendship, I may be permitted to say, there is no name so illustrious that would not derive distinction.

If the seasons of academical study were thus happily and usefully employed by Mr. Tytler, the seasons of the summer vacation were not less so. Upon these occasions he retired to Woodhouselee, the beautiful seat of his father, near Edinburgh, a scene endeared to him by the remembrances of infancy—by all the ties of domestic affection—by the improvements which his father was then annually adding to it—and, perhaps, by those anticipations of greater embellishment which it was afterwards to receive from his own hands. Amid the solitude and quiet of this romantic residence, and at a distance from the prescribed routine of academical labour, he felt all the happiness that arises from the freedom of study, and was at liberty to follow out, without interruption, those literary pursuits to which inclination and taste most strongly inclined him. The character of his age and of his mind led him naturally to those compositions which, as addressed to the imagination and the heart, constitute the polite literature of every country. His knowledge both of the ancient and the modern languages enabled him to indulge this desire; and in the course of successive summers, he seems to have formed and to have executed with this view a plan both of comprehensive and of systematic study.

He began with the great writers of antiquity—the poets, the orators, and the historians of Greece and Rome, to whose works he now returned with that increase of knowledge and that improvement of taste which enabled him more fully to seize and to appreciate their various excellence. He next resumed (though with more enlightened views) the study of Italian literature, and perused with new admiration the writers of that brilliant period which succeeded the revival of letters in Europe, and who, though formed in the great principles of composition upon the models of classic taste, have yet added to them all the splendid courtesy of feudal manners, and all the romantic interest of chivalrous adventure. After the extinction, or (as I trust) only the slumber of Italian genius, he followed the progress of taste into France, and pursued the singular history of composition in that country, from the period that the genius of Corneille first gave to its imperfect language the dignity of poetry to the time that the eloquence of Fenelon, of Buffon, and of Rousseau, rose above the level of its poetic diction, and gave to prose composition all the powers and all the pathos of poetry.

The study of foreign literature led Mr. Tytler naturally to that of his own country; and, in comparing the great writers of England with those of the different nations of the Continent, he was enabled to form a more accurate estimate both of the extent of English genius and the powers of the English language. While engaged in this pursuit, his curiosity was led into a field at that time little cultivated in this country, I mean to the study of the ancient writers of England, those original masters of composition, in whose writings the genius of the people and of the language is most strongly displayed, and who conducted him (in the language of Spenser) to "*the pure well of English undefiled*." The pursuit not only rewarded him at the time, but tended to form his taste in future days; and he was among the first literary men of this country who felt the beauty of our language in its first stage of improvement, and foresaw the advantages that the study of our earlier writers would give to modern composition, by introducing greater unity of character, a purer analogy of construction, and the peculiar energy that arises from idiomatic expression.

The same taste which guided the studies of Mr. Tytler at this period directed also his amusements. The art of drawing, which he had at first begun to practise at Kensington, he now resumed with ardour, amid the beautiful scenery he inhabited. The love of music, which was hereditary in his family, had been cultivated by the example, and under the instructions of his father; and he willingly became a performer, not only to indulge his own taste, but that he might add his assistance to the little family concerts with which that excellent man loved always to close his active day. But the amusement in which at this period Mr. Tytler peculiarly delighted, was that of making excursions to visit the remarkable scenery either of England or of his own country. He had an early love of the great and beautiful in nature; and his sensibility in this respect had been increased by his study of landscape painting. But his taste was not of that servile kind which looks only to the art of imitation: and he felt that there were many other sources of beauty in the scenery of nature than the painter can employ. His mind was open, not only to all those moral expressions which form what has been called the *poetry of nature*, but to all those local and accidental expressions which it receives from the events of time; and he loved to mingle in such scenes with the sensibilities of taste, the associations of poetical description, and the memory of historical events. In this manner Mr. Tytler used always to pass some parts of the summer, or autumnal months; and, in the course of a few years, there were few scenes either in England or in Scotland which he had not visited that were distinguished either by natural beauty, by poetical celebration, by the residence of eminent men, or by the occurrence of memorable transactions. In such employments, to him (as to all who are capable of it) there was something more than amusement; and he never returned from them without feeling his taste improved, his ardour in study animated by the memories of illustrious men, and his love of his country increased, both by the monuments of its former glory, and the appearances of its progressive prosperity.

In the year 1770 Mr. Tytler was called to the bar; and in the spring of the succeeding year, he accompanied his friend and relation Mr. Kerr, of Blackshiels, on a tour to Paris, from which they returned by Flanders and Holland.

The year 1776 was marked by the most important as well as the most fortunate event of his life, by his marriage to Miss Ann Fraser, eldest daughter of William Fraser, Esq. of Balnain—an union which had long been the object of his secret wishes—which now accomplished all the hopes he had formed of domestic happiness; and which, after the long period of 36 years, unclouded almost by misfortune or distress, closed at last in more grateful and profound affection than it at first began.

At this period, when the business and the duties of life were opening fully upon him, Mr. Tytler seems to have made a very deliberate estimate of the happiness that was suited to his character, and to have marked out to himself, with a very firm hand, the course he was afterwards to pursue. His profession opened the road both to professional fame and to civil distinction; and the circumstances of the times were of a kind to animate all his ambition of literary distinction. The period to which I allude was, perhaps, indeed, the most remarkable that has occurred in the literary history of Scotland. The causes which, since the era of the Union, had tended to repress the spirit of literature in this country, had now ceased to operate: the great field of England was now opening to the ambition of the learned; and the ardour with which they advanced into it, instead of being chilled by national prejudice or jealousy, was hailed by the applause of that generous people. The fame of Mr. Hume was now at its summit of celebrity. After the honours with which the Histories of Mary and Charles V. were crowned, Dr. Robertson was laying the foundation of new claims to historical reputation; and in the solitude of his native village, Mr. Smith was preparing that illustrious work which was afterwards to direct the laws and to regulate the welfare of nations. The different Universities of the country were vying with each other in the ardour of scientific pursuit and in the dissemination of useful knowledge; and from them there were annually advancing into life some of those men who have since supported or extended the reputation of their country. The profession of law partook in the general spirit of improvement: the pleadings of the bar began to display a more cultivated taste, and the decisions of the bench to be directed by a more enlightened philosophy. The eloquence of Mr. Lockhart was still occasionally heard; and Mr. Erskine was beginning that brilliant career which so lately only has been closed. Lord Hailes was carrying into the obscurity of our antiquities the torch of severe but sagacious criticism; and Lord Kames was throwing over every subject almost of science or of literature the lights of his own original and comprehensive genius.

These were circumstances sufficient to excite and to justify ambition; but although Mr. Tytler was ambitious, it was not so much of fame he was ambitious as of usefulness. The modesty, as well as the benevolence of his nature, disqualified him for those adventurous speculations in which nothing but personal celebrity is attained; and in looking at the literary scene before him, the path that invited him was not that which rises amid dangers and difficulties into solitary eminence, but that which follows out its humbler and happier way amid the duties and charities of social life. In all his ambition too there was (if I may use the expression) something always domestic. The honours to which he aspired were those which he could share with those he loved; and the "eyes" in which he wished *to read his history* were not so much the eyes of the world as those of his family and friends. It was with this moral and chastised taste that he looked even to the honours of his profession; and when he recollected the brightest distinction it ever received, it was not Cicero in the Forum or in the Senate House that was so much the object of his admiration, as Cicero at his Formian or his Tusculan Villa, amid the enjoyments of domestic friendship and the delights of philosophic study.

With these dispositions, Mr. Tytler soon found that the share of business which a young man can acquire at the bar was insufficient to employ the activity of his mind; and that the merely occasional attention which particular cases required was at variance with those habits of continued study in which he was accustomed to be employed. To consider law as a science was more congenial to his mind than to consider it only as a profession; and he became desirous, therefore, of engaging in some continued work, where (like some eminent men before him) he might entitle himself to the honours of his profession rather by the labour of solitary study than by the celebrity of actual practice. While he was forming this resolution, the advice of his patron and friend Lord Kames not only encouraged him to execute it, but suggested to him also a subject in which it might usefully be executed. As this incident gave origin to the first work which Mr. Tytler published, and as it is descriptive of the benevolent attention of that distinguished man to his younger friends, I am happy to be able to relate it in Mr. Tytler's own words, from a little manuscript account of the principal events of his life, which he has left for the instruction of his family.

——"The first time (says he) I became intimately acquainted with Lord Kames was, I think, in autumn 1767, when he asked my father and me to accompany him on the southern circuit. We passed a few days with him at his estate of Kames, and thence travelled to Jedburgh and Dumfries. From that time I had the satisfaction of perceiving that I had some share in his good opinion, of which he gave me many proofs. While prosecuting my studies in the law, I was wont frequently to resort to him for his advice; and in the vacations I made many excursions to Blair-Drummond, where I staid for 10 days or a fortnight at a time, and partook in all his occupations, either of study or of amusement. Having read to him a little literary dialogue which I had composed, with which he was pleased, he gave me his advice to fill up my intervals of leisure by composing a set of literary essays: in consequence of which, I wrote a few detached sketches, which I showed him from time to time. It was upon one of these visits to Blair-Drummond, about three years after I had put on the gown, that, in talking of some of his law works, he asked me if ever I had attempted to write any thing in the way of my profession. I told him that I had not, but that I was at that time meditating something of that kind. He then proposed to me to write a supplemental volume to his Dictionary of Decisions, bringing down that work to the present time. I told him that the boldness of the undertaking terrified me; but that the good opinion he had shown of me by making such a proposal was certainly a strong inducement to me to make the attempt. I took, however, some time to deliberate upon it; and having at length resolved to undertake the work, I went out again to Blair-Drummond to inform myself of the method he had followed in abridging and arranging the cases. These he communicated to me, and I set to work under his eye. The simple abbreviation of the printed cases occupied me above four years; and during all that time I read over occasionally to Lord Kames the sheets of my abstracts, on which he gave me his notes and emendations. The arrangement of the cases gave me another year's employment; and while this was going on, I showed the sheets from time to time to Lord Kames, a great part of them to Mr. Ilay Campbell, as also to the Lord President Dundas, to all of whom I was much indebted. When the work was completed and printed, I was much gratified to find that Lord Kames was pleased with it. Some passages in the preface, apologizing for defects, he desired that I would strike out. 'The *work* (said he) *does you honour; and a man ought not too much to undervalue his labour, or depreciate his own abilities.*'" This volume of the Dictionary of Decisions was published in folio in 1778; and of the character and value of the work, no other testimony is necessary after the sanction of the great lawyers that have been mentioned.

Mr. Tytler had now avowedly dedicated his life to the pursuits of literature; and his friends became anxious to see him placed in some one of those public literary stations where his talents and his industry might be more conspicuously displayed than in the retirement of private study. An opening of this kind soon occurred, which Mr. Tytler willingly embraced. The late John Pringle, Esq. had been recently appointed to the Professorship of Universal History and Roman Antiquities in the University of Edinburgh; but finding the discharge of the duties of it incompatible with his other employments, had expressed his inclination to resign it. The class (I believe) in its original institution, in this and in other Universities of Scotland, had been intended as subsidiary to the study of the civil law. It had been taught always by members of the Faculty of Advocates, and attended by students of that description: and it had, therefore, that degree of relation to Mr. Tytler's own profession, that forfeited none of the hopes or expectations he might form of its future distinctions. An arrangement was soon made with Mr. Pringle. In 1780, Mr. Tytler was appointed Conjunct Professor; and in 1786, sole Professor of Universal History.

From that period until the year 1800, Mr. Tytler devoted his life almost exclusively to the duties of his Professorship; and ten years of assiduous study were employed in the composition and improvement of the course of lectures which he annually read in the University.

Of the character and value of that course of lectures I should have felt it a duty to have attempted some slight description if I were not prevented by the presence of many, to whom every attempt of this kind would be superfluous, and by the recollection that while they remain unpublished they cannot be the objects of public criticism. I may be permitted, however, to offer to the Society a few observations upon the views with which Mr. Tytler entered upon his Professorship, and upon the plan he pursued in the conduct of his lectures.

The class had hitherto been taught chiefly in relation to the science of law, to which it was considered as subsidiary. It was not so much Universal History that was the subject of prelection as the History of Rome; and the views that were exhibited of Roman antiquities were chiefly those that were illustrative of the principles or progress of the civil law. Mr. Tytler felt that it became him to take a more comprehensive view of the subject; to aim at higher utilities than those of a single profession; to adapt his lectures to the more liberal opinions which had arisen with regard to education, and the increasing celebrity of the University where they were to be delivered; and "in the course of them (as he has himself expressed it) to exhibit a progressive view of the state of mankind from the earliest ages, of which we have any account; to delineate the origin of states and empires; the great outlines of their history; the revolutions which they have undergone; and the causes which have contributed to their rise and grandeur, or operated to their decline and extinction."

In the execution of a design so extensive, Mr. Tytler's attention was first directed to the choice of a *plan*, or to the formation of a system of arrangement by which he might be able to give some degree of unity and consistence to the great mass of materials that were before him. In examining the methods in which academical lectures on this subject had hitherto been conducted, either in this country or on the Continent, he perceived that there were two different systems which had chiefly been followed, and which may, perhaps, not improperly be styled the narrative, and the didactic systems. In the first, the principle of arrangement was simply that of chronology: the only order observed was the order of time; and the only object of the teacher was to convey to the student the knowledge of the succession of historical facts. In the second, the principle of chronological arrangement was altogether disregarded: the events of history were considered not as a branch of knowledge in themselves, but as a ground-work for the conclusions of science; and the great object of the teacher was to convey to the students the knowledge of the general principles of public law and of political philosophy.

In neither of these systems did Mr. Tytler find the utilities which it was his ambition to derive from the subject of his lectures. The first appeared to him only a barren detail of chronological events, in which nothing more was conveyed than the mere knowledge of the succession of these events; and all that is included under the name of the Philosophy of History was necessarily omitted. In the second, he feared that too wide a field was opened to the ambitious speculations of the teacher, and that while the attention of the student was liable to be occupied by hasty or by unfounded theories, the interest of historical narration was necessarily lost, and all the moral instructions of history neglected.

The system which Mr. Tytler finally adopted for his own course of lectures, was one which combined the advantages of both these systems, and was very happily adapted both to maintain the interest and to consult the instruction of the student. In surveying with an attentive eye the ancient history of the world, he observed (to use his own words) "that it was distinguished in every age by one prominent feature; that one nation, or empire, was successively predominant, to whom all the rest bore, as it were, an under-part, and to whose history, we find that the principal events in the annals of other nations may be referred from some natural connexion." In this remarkable feature Mr. Tytler saw that a principle of natural arrangement was afforded him which might give to his course a sufficient degree of unity and order; and which, while it preserved to the student the interest of historical narration, gave to the teacher the opportunity of exhibiting those general views of the progress of the human race, which form the most important instruction we can derive from its history.

It was on this principle that his course of Ancient History was conducted. After some general prospects of what is known of the Assyrian and Egyptian empires, he began with the brilliant and interesting subject of Greece. He treated at length the events of its civil and political history; and in conducting his narrative brought occasionally into view the situation of the nations by which it was surrounded. He then examined the nature of the various governments which distinguished it; the different political institutions which they had adopted; the character of their military establishments; their principles of colonization, and of internal regulation: and when time had conducted him to the melancholy period of the extinction of their independence, he took a retrospective view of its literary history—of the state of its attainments in arts and science; and above all of the nature and causes of that unequalled excellence which it attained in all the arts of taste.

The next great subject which presented itself was the history of Rome; and in the views he took of this magnificent portion of his course, he followed the same arrangement, and employed the same method of instruction. After recounting its obscure origin and infant institutions—after tracing the progress of its political constitution, until it terminated in that illustrious republic, which, though so long extinct, still reigns, as by some magic spell, over the minds and imaginations of mankind, he followed the progress of its arms through a world hitherto unknown; and thus gradually introducing to the observation of his students those various nations of the North that were destined in future years to overturn this mighty fabric, he made the easiest, but the most fortunate, transition to the history of modern Europe, and to the examination of the causes that produced the fall of Rome. At this eventful period, he again availed himself of the pause which history afforded him, to take a retrospective view of this great people—to consider their attainments in arts and arms—to compare their progress in science and in literature with that of the mighty people that had preceded them—and to indulge himself in that illustration of the excellence of their greater writers, which he was so well qualified to give, and which, far better than mere critical examination, was fitted to excite the admiration and to form the taste of the young who heard him.

The history of modern Europe afforded not to Mr. Tytler the same fortunate principle of arrangement which he had found in the ancient; but another principle of connexion presented itself of which he willingly availed himself. To the historian of modern Europe the natural place of observation is his own country—it is the point of view to which all his interests most obviously conduct him, and from which all the events of the surrounding world fall into somewhat of systematic order and harmonious distance. It was on this principle, therefore, that Mr. Tytler conducted his views of modern history. Considering the history of their own country as the subject most important in the instruction of his students, he began by the narration of the great events of its civil and military story: he traced the successive steps of its progress in industry, in legislation, in opulence, and in refinement; and unfolded with care the gradual rise of its political constitution, until it terminated in the memorable era of the Revolution. From this central point of observation, he took occasion, at different times, to direct the attention of his students to the contemporary history of mankind—to mark to them the successive changes that were occurring upon the Continent of Europe—to introduce to them those new empires which at one period the frenzy of fanaticism, and at another the avarice of commerce, had revealed to the European eye—and to awaken their attention to the mighty consequences which the establishment of Christianity, the invention of printing, the discovery of the New World, and the spirit of the Reformation, have had upon the general character, and manners, and happiness, of modern times. With these great subjects he gladly at times interwove the history of literature and science; and while his attention was chiefly directed to the progress of British literature, he led the observation of his students to the contemporary history of learning upon the European Continent, and to the examination of those general causes which had influenced the successive steps of its progress from the time of the revival of letters to the brilliant period when his lectures closed.

The success of this course of lectures was sufficient (as Mr. Tytler has said) "to compensate the labours of the author." They came to form an important part in the system of general education; and he soon numbered among his students not only those who were destined to the profession of the law, but the young of every different description, whose education was conducted upon liberal and philosophical principles. The little volume which he published in 1782, under the title of "Outlines of a Course of Lectures," for the assistance of his students, became so popular that he found himself called upon to present it to the world in a larger form, under the title of "Elements of General History," in two volumes. This work has since passed through four editions, and has been found so useful by those engaged either in the business of private or public education, as affording a concise and luminous arrangement of historical events, that it is now used as a text-book in some of the principal seminaries of education in England, and has become (as I understand) the ground-work of historical study in some of the Universities of America. Of the lectures themselves, while they remain unpublished, it would be preposterous to offer any opinion; yet, when they are given to the world, I shall be much deceived if they are not found to fill up an important desideratum in English literature—to afford to the minds of the young more pleasing and more enlightened views of the history of man and the progress of the human race than any other similar work in our language presents them, and to accomplish the generous ambition of their author, *in rendering the study of history subservient to the great end of all education, that of forming good men and good citizens.*

The labours in which Mr. Tytler was thus employed were sufficient to occupy, but not to engross, his attention. He continued assiduously his practice at the bar; and he followed, with the interest of a man of letters, the progress of science and philosophy around him. The reputation which his taste and talents had now acquired created many appeals to him for literary advice or assistance; and to him every labour was welcome in which he could serve the cause either of literature or of friendship.

In 1778, when Dr. Gregory was publishing an edition of the works of his father Dr. John Gregory, he solicited Mr. Tytler to prefix to it a short account of his life and writings. It was a task which Mr. Tytler willingly undertook, from his early acquaintance with that eminent and amiable man; and he executed it with the simplicity almost of filial reverence and affection.

The year 1779 was distinguished in this country by the appearance of the celebrated periodical paper, " The Mirror." Of the progress of a work which, both in its design and execution, did so much honour to Scotland, Mr. Tytler could not be an indifferent spectator. Although not properly a member of the Society, he was yet the friend of all who were known to be members of it. To the beauty and excellence of the serious papers in this work, Mr. Tytler felt that nothing could be added; but it seemed to him that something was wanting upon the side of levity and gaiety; not only for the purpose of temporary popularity, but to give to the serious papers themselves their proper importance and relief. With this view, he contributed to the Mirror the papers, Nos. 17, 37, 59, and 79; and in 1785, to the Lounger, the papers Nos. 7, 9, 24, 44, 67, 70, and 79.

Of these papers the original manuscript happens still to remain; and it affords a very pleasing memorial of the manner in which Mr. Tytler was accustomed to pass his most vacant hours. The manuscript occupies the blank leaves of some sketch books, with which Mr. Tytler always travelled, for the purpose of landscape-drawing, and was written at inns in the evenings after the journeys of the day were done. It was in this manner that the cheerful activity of his mind found employment and amusement every where; and that the hours which most men pass in indolence or fretfulness were passed happily by him in the offices of friendship, or in the enjoyments of elegant composition.

On the institution of the Royal Society in the year 1783, Mr. *Tytler* was one of its constituent members, and was unanimously elected one of the Secretaries of the Literary Class—an office which he continued to fill with zeal for many years; and in the execution of which he drew up that "Account of its Origin and History," which is prefixed to the first volume of its Transactions.

In 1788 he contributed to the Royal Society a biographical memoir of the late Robert Dundas, of Arniston, Lord President of the Court of Session—a paper valuable, not only for the just and vigorous delineation which it gives of the character of that eminent Judge, but for the interesting account it affords of some of the earlier branches of a family so long and so honourably distinguished in the legal annals of Scotland.

In 1789 Mr. Tytler read a paper to the Royal Society upon "The Vitrified Forts in the Highlands of Scotland." Of these singular antiquities, the prevailing theory had been, that the vitrification was produced in the process of their erection, and that it was the substitute of a rude age for cement. The theory which Mr. Tytler suggested was the reverse of this; that the vitrification was the result not of their erection, but of their destruction; and that it was produced by the efforts of enemies in attempting this destruction by fire. The theory is certainly not without some appearances of probability: it assimilates sufficiently with the period of society to which such buildings undoubtedly refer; and Mr. Tytler was able to support it with learning and ingenuity. Of the impression it made at the time upon the Society, I am happy to be able to refer to an evidence of no little weight, in a letter from our late illustrious associate Mr. Smith to Mr. Tytler upon the subject; and, although the letter is very short, I persuade myself that it will not be unacceptable to the Society, both because there are unhappily very few letters of this great man remaining, and because it involves also the memory of some other men whose names can never be listened to in this place without emotion.

"DEAR SIR,

"I have read over your paper with the greatest pleasure. The composition is what it ought to be, simple, elegant, and perfectly perspicuous, and will be a very great ornament to our Memoirs. Some of my chemical friends, however, are of opinion, that the degree of vitrification which takes place in the specimens of these forts is too great to be the effect of any accidental fire, such as you suppose, and could be produced only by a great accumulation of wood, heaped upon the wall after it was built. This is a subject of which I am ignorant. You had convinced me, who fancied that this imperfect vitrification was more likely to be the effect of accident than of knowledge. The friends I mean are Dr. Black and Dr. Hutton, who in every other respect entertain the same high opinion of your composition which I do. You had better converse with them: you may convince them, or they may convince you; and even though neither of these two events should happen, the offence, I apprehend, will not be great, either to them or to you. I have the honour to be, &c.

"Adam Smith."

In the year 1790, Mr. Tytler read in the Society those papers on Translation, which they who heard them will remember to have been listened to with so much pleasure, and which he soon after published without his name, and under the modest title of an "Essay on the Principles of Translation." The work was scarcely published when it occasioned a correspondence with the late learned and ingenious Dr. Campbell, Principal of Marischal College, Aberdeen, from which, however painful at first, Mr. Tytler might easily have foretold its future fortune in the literary world. Dr. Campbell had, some time previous to this, published his Translation of the Gospels, to which he had prefixed, in a preliminary dissertation, some very acute and ingenious observations upon the principles of translation. Upon the publication of Mr. Tytler's anonymous work, he immediately procured it, and was so much struck with the coincidence of their views upon the subject that he wrote to his printer Mr. Creech to know who was the author; and while he acknowledged himself "to have been flattered not a little to think that he had in these points the concurrence in judgment of a writer so ingenious," he expressed at the same time some suspicion that the author might have borrowed from his Dissertation without acknowledging the obligation. Mr. Creech, with great propriety, communicated the letter to Mr. Tytler; and he instantly wrote to Dr. Campbell, acknowledging himself to be the author, but assuring him that the coincidence of sentiment was purely accidental, and that the name of Dr. Campbell's work had never reached him until his own had been composed. "The coincidence of our general principles (says Mr. Tytler) is indeed a thing flattering to myself; but I cannot consider it as a thing at all extraordinary. There seems to me no wonder that two persons moderately conversant in critical occupations (I am far from thinking equally so) sitting down professedly to investigate the principles of this art, should hit upon the same principles, when, in fact, there are none other to hit upon, and the truth of these is acknowledged at their first enunciation. In my opinion there would, on the contrary, be just matter of wonder if they did not hit upon them. But in truth (concludes Mr. Tytler), the merit of this little essay (if it has any) does not, in my opinion, lie in these particulars. It lies in the establishment of those various subordinate rules and precepts which apply to the nicer parts and difficulties of the art of translation; in deducing those rules and precepts which carry not their own authority *in gremio* from the general principles which are of acknowledged truth, and in proving and illustrating them by examples. How far you may have anticipated me even in this respect, I cannot say until I have perused your Dissertations. They appear to contain a rich mine of philological and critical learning; and I am confident that if my book comes to a second edition, I may be able to profit much by your remarks. In that case I shall most cordially, and with the highest pleasure, acknowledge my obligations."

To those that are acquainted with the character of Dr. Campbell, it will be unnecessary to add that he received Mr. Tytler's explanation with the most candid and polite liberality. "The letter which you favoured me with (says he) made me both ashamed and vexed that I should have been so rash as to express myself to Mr. Creech in a manner which could give a moment's uneasiness to a man of merit, especially one whom I consider myself as having the honour to call a friend. When I wrote that letter, I neither knew nor suspected who the author of the Essay was. Had I known what I now know, the name of the author alone would have convinced me that the coincidence was merely accidental. Your arguments are good, but I was sorry you had recourse to them; sensible as I am that if your declaration had not been sufficient to satisfy me, I did not deserve to be satisfied. Mathematical demonstration, were you to attempt it, would not give me stronger conviction than I already have, that what you say is the truth. But to have done with the disagreeable part of this mistake (he concludes), I cannot avoid mentioning one circumstance in this incident, which to me is always extremely agreeable, the evidence which it gives of a concurrence in sentiment upon critical subjects with persons of distinguished ingenuity and erudition. Such a discovery makes a man more confident in the justness of his own sentiments. I have only to add, that your illustrations of the general doctrines, and your examples from the ancients, please me exceedingly."

The opinion of Dr. Campbell was very soon justified by the voice of the literary world; and I believe that there is no work of literary criticism which this country has produced that so soon attained celebrity in England as the Essay on Translation. The different reviewers of the day contended with each other in the earliness of their notice, and in the liberality of their praise. The most celebrated scholars of England, Dr. Markham, Archbishop of York, Dr. Douglas, Bishop of Salisbury, Dr. Percy, Bishop of Dromore, Dr. Vincent, of Westminster, and Dr. Watson, of Winchester schools, wrote to the author in terms of high approbation. "Were I not afraid (says Mr. Murphy, the well-known translator of Tacitus, in a letter to the author) of being thought a dealer in compliment, I should say that I esteem it the best performance I have ever seen on the subject. Ingenious hints and cursory remarks are to be found in many authors, ancient and modern; but they remained scattered, and nothing like a regular system has been formed until now." And Mr. Cumberland, the extent of whose learning, and the fertility of whose genius, gave so much value to his opinion, was so much delighted with the work, and so grateful for the just praise which Mr. Tytler had bestowed upon his admirable translations from the fragments of Greek comedy, that he wrote to his friend Sir William Forbes to beg of him to procure Mr. Tytler's permission to dedicate to him a translation of "The Clouds of Aristophanes," which he was then preparing, and which the praise of so distinguished a critic had encouraged him at first to undertake. To the opinion of these eminent men it may be supposed I very willingly subscribe; yet, I must add, that the work has always appeared to me as entitled even to a higher praise. In its plan, indeed, it appears to relate only to the principles of translation; but in its execution, it necessarily involves the principles of composition in general; and in the nature and variety of the examples he adduces, and the acuteness and delicacy of the criticism he employs, Mr. Tytler seems to me to have made use of one of the happiest methods to lead the minds of his readers to a sense of those fine and evanescent beauties in composition, which abstract language can so imperfectly express, and which affords the best preparation, not only for the task of translation, but for the higher purpose of original composition.

The "Essay on the Principles of Translation" has now passed through five editions, in each of which the author has been anxious to repay the approbation of the public, by the additions he has made; and, after the experience of 15 years, it may now be considered as one of the standard works of English criticism.

While Mr. Tytler was thus actively and usefully employed, the government of Scotland began to consider him as one who was fitted to share in its administration; and Lord Melville thought himself now entitled, by the character which Mr. Tytler had established, to testify to the public the sentiments of his private friendship. His practice at the bar, though not extensive, had been respectable; and in the conduct of it he had shown sufficiently the talents he possessed for business. His honour was high; his integrity acknowledged; and his manners amiable and conciliating. His political opinions were those of hereditary loyalty; and in the acceptance, therefore, of office, he had none of those sacrifices of principle to make by which the course of political ambition has been sometimes degraded. In the year 1790, he was appointed Judge-Advocate of Scotland, in the room of Mr. Charles Hope.

The office of Judge-Advocate it had hitherto (I believe) been usual to execute by deputy; but Mr. Tytler was not of a character to make any compromise with duty, or to accept of office, without accepting of all its obligations. He made it his business, therefore, to attend upon every trial: he gave to every case his most careful and considerate attention; and so anxious was he to fulfil his duty to the utmost, that he took the trouble of drawing up for his own direction, a "Treatise upon Martial Law," which afterwards, when he retired from the office, he gave to the public, and which has (I understand) been found of the most important use in the decision of cases of this kind.

Into the detail of Mr. Tytler's conduct in the discharge of this delicate but important office, it would be presumptuous in me to enter; but I may be permitted to relate, from his correspondence, a single incident, which illustrates both the conscientiousness with which he discharged his duty, and the respect in which his opinion was held by those who were then at the head of the military department.

A court-martial had been held at Ayr, with the sentence of which Mr. Tytler was extremely dissatisfied; and to the injustice of which he had anxiously, but in vain, endeavoured at the time to awaken the attention of the Court. Upon transmitting the proceedings to London, Mr. Tytler thought it his duty to communicate the grounds of his dissatisfaction with the sentence to Sir Charles Morgan, then Judge-Advocate-General, and, in the most earnest terms, to implore his attention to the case, if his Majesty should (as was probable) refer it to his decision. Sir Charles Morgan cheerfully undertook the revision of the case: his opinion coincided in every respect with that of Mr. Tytler; and to the letter in which Sir Charles communicated to him his Majesty's disapprobation of the sentence, Mr. Tytler added the following note: "I have thus had the satisfaction of procuring from his Majesty a disapproval of this very unjust sentence, and a rectification of it in every point where it was wrong."

In the year 1792 Mr. Tytler had the misfortune to lose his father, at the advanced age of 81. Of the character of this excellent man, the Society already possesses a description by Mr. Mackenzie, which no one will attempt to improve. The loss to his son was of a kind which it is the fortune of few men to experience. Their connexion had subsisted for the long period of 45 years, undiminished by distance, and unbroken by misunderstanding; and there was so singular a correspondence in their tastes, their pursuits, their principles, and even their prejudices, that Mr. Tytler felt he had not only lost a father, but his best and oldest friend. His first employment was to design a little monument to his memory, which he soon after erected in the pleasure-grounds of Woodhouselee, upon a spot which his father had particularly loved; and he engraved upon it the following inscription, which so well expresses the filial tenderness of the author, and so happily obeys that profound and merciful propensity of sorrow, which leads us still to fill the scenes we love with the presence of those we have lost.

M. S.
GULIELMI TYTLER, de Woodhouselee,
H. L. P. F.

En virides aras, en hanc quam ponimus urnam,
Tu, fili ex manibus respice dona, Pater!
Sic, venerande Senex, olim qua rura placebant
Sint eadem busto nunc decorata tuo.
Neve Tibi desit post funera sueta voluptas,
Proximo ab umbroso cantet avis nemore,
Et qui Te placido lenibat murmure rivus,
Dulcia perpetuis somnia portet aquis.

By the death of his father, Mr. Tytler had succeeded to the estate of Woodhouselee; and some years before that period Mrs. Tytler had, in a similar manner, succeeded to the paternal estate of Balnain, in Inverness-shire. He was now in circumstances of affluence—his friends were numerous—his own disposition in the highest degree hospitable and kind—and he felt himself at liberty to attempt to realise some of those visions of retired and rural happiness which had long played in his imagination, and which form, perhaps, one of the earliest reveries of every generous or cultivated mind. He began, therefore, immediately to embellish his grounds, to extend his plantations, and in the enlargement of his house to render it more adequate to the purposes of hospitality; and in the course of a short period, he succeeded in creating a scene of rural and domestic happiness which has seldom been equalled in this country, and which, to the warm-hearted simplicity of Scottish manners, added somewhat of the more refined air of classical elegance. It was here, from this period, that all his hours of enjoyment were passed—that all his works were composed—and that, in the bosom of his family, and amid the scenery and amusements of the country, he found the happiness that was most congenial to his character and disposition.

His morning hours were uniformly given to study; but his studies were of a nature that tended rather to animate than to fatigue his mind. It was not in abstract or metaphysical speculations he was engaged, where the understanding only is exercised, and where the progress of discovery is so little proportioned to the time or labour that is employed; nor in works of imagination, where the mind is ever in pursuit of that ideal excellence which it is never destined to attain. The historical, the antiquarian, or the critical studies, in which he was engaged, required no painful concentration of thought, and no laborious processes of reasoning. They related to the deeds and language of men, where it was not the understanding alone that was employed, but where the imagination and the heart were perpetually exercised; and he could rise from them to the common business or offices of life, with a mind undistracted by doubt, and unfatigued by abstraction. The employments to which he gave his hours of exercise were of the same gentle and cheerful kind. He had little relish for the sports of the field, unless angling, in which, like the amiable and contemplative Walton, he had from his early days delighted; but he took great delight in gardening, in the embellishment of his pleasure-grounds, and, more than all, in improving the dwellings, and extending the comforts of his cottagers—an occupation, in which taste so fortunately combines with beneficence, and in which, for all the labour or expense he bestowed, Mr. Tytler found himself every day rewarded, by seeing the face of nature and of man brightening around him.

The society that assembled at his table was the best that at that period this country afforded—his own family-relations—the families of the neighbouring proprietors in the populous county of Mid-Lothian—most of the men eminent in science or in literature, of which our metropolis was then so profuse—and occasionally those strangers of distinction whom the love of science or of nature had induced to visit Scotland. His hospitality was cordial, but unobtrusive—his attentions were so unostentatious that his visitors found themselves at once at home; and he himself appeared to them in no other light than as the most modest guest at his own table. The conversation which he loved was of that easy and unpremeditated kind in which all could partake, and all enjoy. To metaphysical discussion, or political argument, he had an invincible dislike; but he gladly entered into all subjects of literature or criticism; into discussions on the fine arts, or historical antiquities, or the literary intelligence of the day; and when subjects of wit or humour were introduced, the hearty sincerity of his laugh, the readiness of his anecdote, and the playfulness of his fancy, showed to what a degree he possessed the talents of society. His sense of humour was keen, but at the same time characteristic: it was the *ludicrous*, rather than the *ridiculous*, in character or in manners, which amused him: those excesses rather of the amiable than of the selfish or sordid passions, which are observed with a sentiment of tenderness as well as of disapprobation, and which the poet has so happily expressed by the phrase, *circum præcordia ludit*. The humour of most men is unhappily mingled with qualities which add little to the amiableness, and still less to the respectability of character. From the gayest conversation of Mr. Tytler, on the contrary, it was impossible to rise, without a higher sense of the purity of his taste and the benevolence of his nature.

His evenings were always passed in the midst of his family, either in joining them in the little family concerts with which, like his father, he always wished to close the day, or in reading aloud to them some of those works by which he thought their tastes or their minds might be improved; or, not unfrequently, when none but his more intimate friends were present, in sharing with his younger children in those various youthful amusements which contribute so much to the gaiety of domestic life, and in which the affections of kindred and the love of home are so well, though so insensibly, cultivated.

Of this scene of simple and virtuous happiness there are some present who will not easily part with the remembrance, though accompanied with the melancholy reflection, that they can meet it no more; and Mr. Mackenzie will, I trust, forgive me for reminding him of an expression which he used to me many years ago, when I accidentally met him upon the road as he was returning from Woodhouselee, and which conveys so much better than any thing I can say, the character of the scene. "I hope (said he) that you are going to Woodhouselee; for no man can go there without being happier, or return from it without being better."

To this picture, however, there is yet another feature to be added: it is in the sentiments with which Mr. Tytler felt the prosperity he enjoyed. In the little MS volume from which I have formerly quoted (and from which I should more frequently quote, if I did not feel it a kind of profanation to expose to the eyes of the world that train of secret thought which was intended only for the eyes of his children), I find the following passage, for the introduction of which, I am sure I need no apology, and which expresses, in a manner which no biographer can do, the governing principles and persuasions of his mind. It was written on his birth-day, Oct. 15, 1795.

"I have this day (says he) completed my 48th year, and the best part of my life is gone. When I look back on what is past, I am humbly grateful for the singular blessings I have enjoyed. All indeed that can render life of value has been mine. Health, and peace of mind; easy, and even affluent circumstances; domestic happiness; kind and affectionate relations; sincere and cordial friends; a good name; and, I trust in God, a good conscience. What, therefore, on earth have I more to desire? Nothing: but if He that gave so please, and if it be not presumption in me to pray—a continuance of those blessings. Yet, if it should be otherwise, let me not repine. I bow to His commands, who alone knows what is best for his creatures; and I say with the excellent Grotius,

"Hactenus ista: latet sors indeprensa futuri:
Scit, qui sollicitum me vetat esse, Deus.
Duc genitor me magne! Sequar, quocunque vocabor,
Seu Tu læta mihi, seu mihi dura, paras.—
Sistis in hac vita? Maneo, partesque tuebor
Quas dederis. Revocas, Optime? Promptus eo."

The melancholy change for which Mr. Tytler seems thus to have prepared his mind was soon to take place. In the autumn of the year 1795 he was seized with a long and dangerous fever, accompanied with delirium, and tending frequently to relapse. Under the anxious care of his friend and physician Dr. Gregory, he recovered from the fever; but in one of the paroxysms of the disease, he had the misfortune to rupture some of the blood-vessels of the bladder—an accident which not only protracted his recovery at the time, but which threatened to degenerate into one of the most painful diseases to which the human frame is subject.

In the state of weakness and suffering which succeeded this severe illness, Mr. Tytler was for a long time incapable of returning to his professional studies: but his mind was incapable of inactivity; and he turned willingly to those pursuits in natural history which had formed the amusement and the delight of his youth, and which are, perhaps, of all others, the most suitable to the grateful feelings of convalescence.

Among the works with which he now amused himself was the once celebrated treatise of Dr. Derham, entitled "Physico-Theology." In perusing it again, with all the affecting associations which the past and the present afforded him, he could not but lament that it was in some degree rendered obsolete by the innumerable discoveries with which science has been enriched since its publication, and that its popularity among those to whom it might be most serviceable was restrained by the number of Latin quotations which remained without a translation. It occurred to him that his hours of convalescence could not be better employed than in remedying these defects, and in thus extending the usefulness of a work of which he had himself felt the value. This pleasing and unfatiguing task he executed with his usual ardour, and prefixing to it a short but valuable dissertation on Final Causes, published it in the year 1799.

Of this work it is unnecessary for me to enter into any further detail; but I cannot omit a passage relating to it which I find among Mr. Tytler's papers, and which marks distinctly the great principle by which his studies as well as his conduct were governed.

"Of all my literary labours (says he), that which affords me the most pleasure on reflection is the edition which I published of 'Derham's Physico-Theology.' The account of the Life and Writings of Dr. Derham, with the short dissertation on Final Causes, the translation of the notes of the author, and the additional notes, containing an account of those more modern discoveries in the sciences and arts which tend further to the illustration of the subjects of the work, are all the original matter of the edition to which I have any claim; so that the vanity of authorship has a very small share in the pleasure I enjoy from it. But when engaged in that work, I had a constant sense that I was well employed in contributing, as far as lay in my power, to those great and noble ends which this most worthy man proposed in his labours, by enforcing on the minds of mankind the conviction of an all-wise and all-beneficent Author of Nature. The demonstration, in short, of that great and central truth, on which depends our present happiness and our future hopes. Since the publication of this edition, some other excellent works have appeared upon the same subject, from which many valuable additions may be made to the Notes on Derham, and I intend, accordingly, to make those additions, if a new edition should be wanted in my lifetime."

The year 1799 was distinguished by the agitation of the great question with regard to the Union with Ireland; and in attending to the debates it occasioned, Mr. Tytler thought that no view of the subject could be better fitted to conciliate the minds of the Irish people to this important measure, than a representation of the benefits which Scotland had derived from the Union with England. These observations he threw into the form of a letter; and they were published at Dublin, with the title of "Ireland profiting by Example; or, the Question considered, Whether Scotland has gained or lost by the Union?" Of this little work it is enough to say, that such was its merit, or its popularity, that three thousand copies were sold upon the day of its publication.

In the year 1801, a vacancy occurred in the Bench of the Court of Session, by the death of Lord Stonefield. The friendship of Lord Melville had a new opportunity for its display; and the friends of Mr. Tytler had now the satisfaction of seeing him elevated to the highest honours of his profession. On the 2d of February, 1802, he took his seat upon the Bench with the title of Lord Woodhouselee.

Of Lord Woodhouselee's qualifications for this important office, it would be presumptuous in me to offer any opinion; and I feel, with gratitude, that it is unnecessary, as, of all the honours which the Government of this country has to bestow, those which have been in the estimation of the public most purely won, and most honourably worn, are those which belong to the Administration of Justice. He brought not to the Bench, indeed, either that profound acquaintance with the details of law, which nothing but continued and extensive practice can give; nor that metaphysical acuteness, which so often seeks to distinguish itself by subtlety of distinction, or novelty of interpretation; nor that impatient eloquence which loves to find in the most trivial cases, an opportunity for its own display. But he brought to it qualities, in a country like this, of higher value, and of more genuine usefulness,—a just and enlightened admiration of the laws he was called to administer,—the most conscientious patience in the investigation of truth,—and a mind incapable either of being intimidated in the discharge of duty, by the dread of censure, or of being misled by the love of praise. In his conduct on the Bench, the characteristic integrity and modesty of his nature were apparent. In this, as in all other situations, his highest ambition was to be *par negotiis, non supra*,—to be able to fulfil his duty without seeking for personal fame; and to accommodate his conduct, not so much to the opinion of men, as to that higher standard which existed in his own breast. There were, however, occasions when his powers were more peculiarly called forth; and, upon some of these appearances from the Bench, there are many of us who can remember the high praise that was bestowed by the late Lord President Blair,—a man whose praise was fame, and who was of too proud an integrity to bestow it where he did not feel it was deserved.

From the period of his elevation to the Bench, Lord Woodhouselee devoted his time exclusively, (while the Courts were sitting) to the business that arose; but, during the vacations, he was always happy to return to his private studies. The solitude of the country (to which he then always retired) invited him to labour; and as he was now free from his academical engagements, and from that continued attention which the improvement of his lectures occasioned, he had time to return to the consideration of some of the literary projects which he had formed in his earlier days, and which he hoped be might now be able to resume. One of these, I find, was the literary and political life of Buchanan; a subject which was interesting to him from many associations, and in which he proposed to do ample justice to his genius as a poet, and his merits as a historian, but to examine, with firmness and accuracy, his conduct as a man, and as a politician.

Another was to give a faithful translation of Camden's Annals of Elizabeth, illustrated with notes, and comparing it with the best accounts of her time that have since been published. The subject had been suggested by Dr. Campbell in the Biographia Britannica, and in the view which Lord Woodhouselee took of it, it promised him the opportunity of exhibiting a fuller and more faithful picture of that interesting period in English history, than had yet been accomplished in any one performance in our language. The most important, however, of these literary projects, was that of a continuation of Lord Hailes's Annals of Scotland, from the period when Lord Hailes's researches closed, to the accession of James VI. to the Crown of England; a work to which no common talents were adequate, and of the difficulty of which no stronger evidence can be given, than that, however desired, it has yet remained unattempted.

All these projects, however, yielded to another, which was much more interesting to Lord Woodhouselee himself, and to the accomplishment of which he was animated by something more than the hope of literary fame,—this was the Life of his earliest friend and patron Lord Kames. "He had waited (as he says, with his usual modesty) for more than twenty years, in the hope of its falling into abler hands." He was now raised to the same Bench which had been dignified by the presence of Lord Kames; and the business in which he was engaged served every day to bring him to his remembrance, and to afford him new opportunities of appretiating his learning and his genius. From this fortunate concurrence of circumstances, Lord Woodhouselee felt himself emboldened to undertake the task, and having determined upon his plan, he entered with eagerness upon the study of his works, and the collection of materials; and in the course of the vacations of only four years, he was able to accomplish his design. The work was finally published in two volumes, quarto, in the year 1807, with the title of "Memoirs of the Life and Writings of Henry Home, Lord Kames."

It is impossible not to admire the motives which led Lord Woodhouselee to this undertaking, and it is impossible also not to respect the ability with which, amid the distractions of public business, and the sufferings of infirm health, he has been able to execute it; yet I know not if the friends of Lord Woodhouselee's literary fame have not some reason to lament his choice of a subject; and there are circumstances in the extent and variety of Lord Kames's powers, which seem to me to place him almost beyond the reach of the biographer.

The fortunate subjects of biography are those where some powerful and uniform interest is maintained,—where great minds are seen advancing to some lofty and determinate object,—and where, amid the toils or the difficulties they have to encounter, the mind of the reader feels somewhat of the same anxious and unbroken interest, with which we follow the progress of the drama, or the narrative of the epic poet. The lives of conquerors, and of legislators,—of discoverers in science, or of inventors in the arts,—of the founders of schools in philosophy, or of sects in religion, it is impossible even for the rudest hand to trace, without awakening an interest which all men can understand, and in which all can participate; and even the history of inferior men can yet always be made interesting, when one object of ambition is seen to be steadily pursued, and one correspondent sympathy is awakened. Of this unity of pursuit, and of interest, the life of Lord Kames was singularly destitute. There was a vigour in his powers, and an elevation in his ambition, that were incapable of being restrained within the limits of any one pursuit; and he seems to have felt it to be his peculiar destiny, to take the lead in every science by which the reputation of his country could be exalted, and in every art by which its prosperity could be increased. To delineate the progress of such a mind,—to follow his steps in all the various fields of inquiry through which he travelled,—to mark with precision the accessions that science derived from his labours, or the arts from his suggestions, was a task to the execution of which few men could bring adequate knowledge or capacity;

and, even if it could have been executed, there were still fewer readers who could preserve any continuity of interest in a progress so eccentric, or be able to make perpetual transitions from the subtleties of metaphysics to the details of husbandry, or from the refinements of philosophical criticism to the technical questions of Scotch law. The emblem of Lord Kames's genius was not that of the Ganges or the Indus, which roll forward their condensed streams, and fill the eye of the spectator with their simple and increasing majesty; but that of the Rhine or the Nile, which divide the volume of their waters into innumerable branches, and, while they fertilize a wider surface, yet perplex the eye that labours to number and pursue them. What fidelity and affection could do upon a subject so difficult, Lord Woodhouselee, I apprehend, has done. He has given the portrait of Lord Kames, with all his various and characteristic features;—he has *surrounded him with his contemporaries*, and sketched out, in many pleasing and interesting details, the literary history of the age in which he lived;—and his work, like those of Plato and of Xenophon, will descend to posterity with an interest which no other can now possess, that of being executed from the living subject, and of blending the veneration of the disciple with the fidelity of the historian.

In the year 1811, Lord Woodhouselee was appointed to the Justiciary Bench, on the elevation of the Lord Justice-Clerk Hope to the President's chair.

Although Lord Woodhouselee was now advancing in age, and his strength declining, yet the publication of the Memoirs of Lord Kames did not put a period to his literary activity. It was now too late, indeed, for him to resume any of the literary projects which he had once hoped to accomplish: but he returned willingly to another occupation, with which he had always intended to close his literary career. This was the revision of his lectures upon history. In the composition of these lectures, the best years of his life had been employed, and at the distance of time that had intervened, he was now able to review them with the eye of impartial criticism, and to make such additions or alterations as might better fit them for that general usefulness for which they were originally intended. To this pleasing occupation all his remaining seasons of leisure were devoted; and with the usual cheerfulness of his temper, he flattered himself that he might be able to accomplish a revision of the whole of the lectures that composed his Academical Course. As the first great subject of these lectures related to Grecian History, he now began anew the study of the Greek historians; and as his views included the history of science, of literature, and of the fine arts, he was led insensibly to the study of the moralists, the orators, and the poets of that interesting period. So fascinating to his mind was the occupation, that, in the course of a few vacations, he was able to compose anew the whole of his lectures upon Grecian History, and to be rewarded by that peculiar delight (which has been so often observed in the later years of literary men), the delight of returning again to the studies of their youth, and of feeling, under the snows of age, the cheerful memories of their spring.

In the year 1812, the death of his friend and relation General Sir James Craig (the late Governor of Canada), and the property to which he succeeded by his will, rendered it necessary for Lord Woodhouselee to undertake a journey to London. As Sir James Craig had been distinguished by the Order of the Bath, it became the duty of Lord Woodhouselee, as his nearest relation, to return to the Prince Regent the ensigns of the Order; and for this purpose his Royal Highness was pleased to grant him an audience. Of this interview Lord Woodhouselee always spoke with gratitude, not only as it afforded him the opportunity of observing that dignified courtesy by which the manners of the Prince Regent are distinguished, but as it showed him the intimate acquaintance which his Royal Highness possessed with regard to the affairs of Scotland, and the interest which he took in her progress in science and in literature. Some time after the interview with the Prince Regent, it was intimated to Lord Woodhouselee, that, if agreeable to him, the dignity of Baronet would be conferred on him, which he requested permission to decline,—an instance of modesty which surprised no one to whom Lord Woodhouselee was known; and which (I am proud to say) was to none so acceptable as to his own family, to whom no illustration could be so dear as that of their father's name.

I am led, besides, to mention this journey of Lord Woodhouselee to London, as it gives me the opportunity of introducing a little composition to which it gave occasion, and which ought not to be omitted in any account of his life. He had for some time believed that the disease under which he laboured was soon to be fatal; and a little before this he had given orders that his family burial place should be repaired, and had inscribed upon it an epitaph, full of tenderness and of affection, to the memory of his father and his mother. In leaving London for the last time, and returning to his own country, it was natural for him to look forward to the event which he had long thought approaching, and to that final home where he was to rest with his fathers. Under these impressions the following lines were composed, as he was returning homewards; and as they afford a picture of his mind which no biographer could reach, I trust I need no apology for introducing them in this place.

The Verses are entitled, "in Sepulchrum meum avitum, in Cemeterio Franciscanorum Edinburgi, nuper re-ædificatum."

Jam duodecimum condere lustrum
 Contigit,—et jam cernere canos
Vertice summo, dum fatiget
 Impigra quondam membra gressus,

Nec oculi vigeant nec aures,
Hebeat et prorsus sensuum acumen.—
—Hæc sunt nec tardæ indicia mortis.—
Hisce admonitus Fati nunciis,
Refici avitum denuo Sepulchrum
Curo, et cineris protegi injuria
Mistæ ut amicis reliquiis cubent,
—Hic enim juncti quondam vita
(Nec sivit divelli fatum),
Dormiunt una Pater et Mater,
Purusque et pius ordo Parentum.——
——Salve! O vitaï Anchora et Portus!
Salve! laborum terminus et quies!
Salve! brevi subeundaque tecta
Hospitium viatori fesso!
Te specto impavidus; te longam
Per noctem fidus sis custos;
Et reddas (precor) incolumem DEO.

The event to which Lord Woodhouselee thus steadily looked forward was now approaching. In June, 1812, after superintending his workmen in some improvements he was making at Woodhouselee, he felt that he had fatigued himself, and he was soon sensible of the recurrence of the same unfortunate accident which had laid the foundation of so many years of suffering. From this period, the remainder of his life was a scene of continued pain and increasing debility,—borne, indeed, with the most calm and even cheerful resignation, and relieved by every thing that filial and conjugal tenderness could supply, yet too visibly approaching to a period which neither tenderness nor magnanimity could avert.

In the beginning of winter, he was prevailed upon to leave his favourite Woodhouselee, and to remove into town; and from this time his disease appeared to make a more rapid progress. On the 4th of January, 1813, he felt himself more than usually unwell; and in the evening, when his family, with their usual attentions, were preparing to read to him some work of amusement, he requested that they would rather read to him the evening service of the Church, and that they might once more have the happiness of being united in domestic devotion. When this was finished, he spoke to them with firmness, of the events for which they must now prepare themselves: he assured them that to him death had no sorrow but that of leaving them; he prayed that Heaven might reward them for the uninterrupted happiness which their conduct and their love had given to him; and he concluded by giving to each of them his last and solemn blessing.

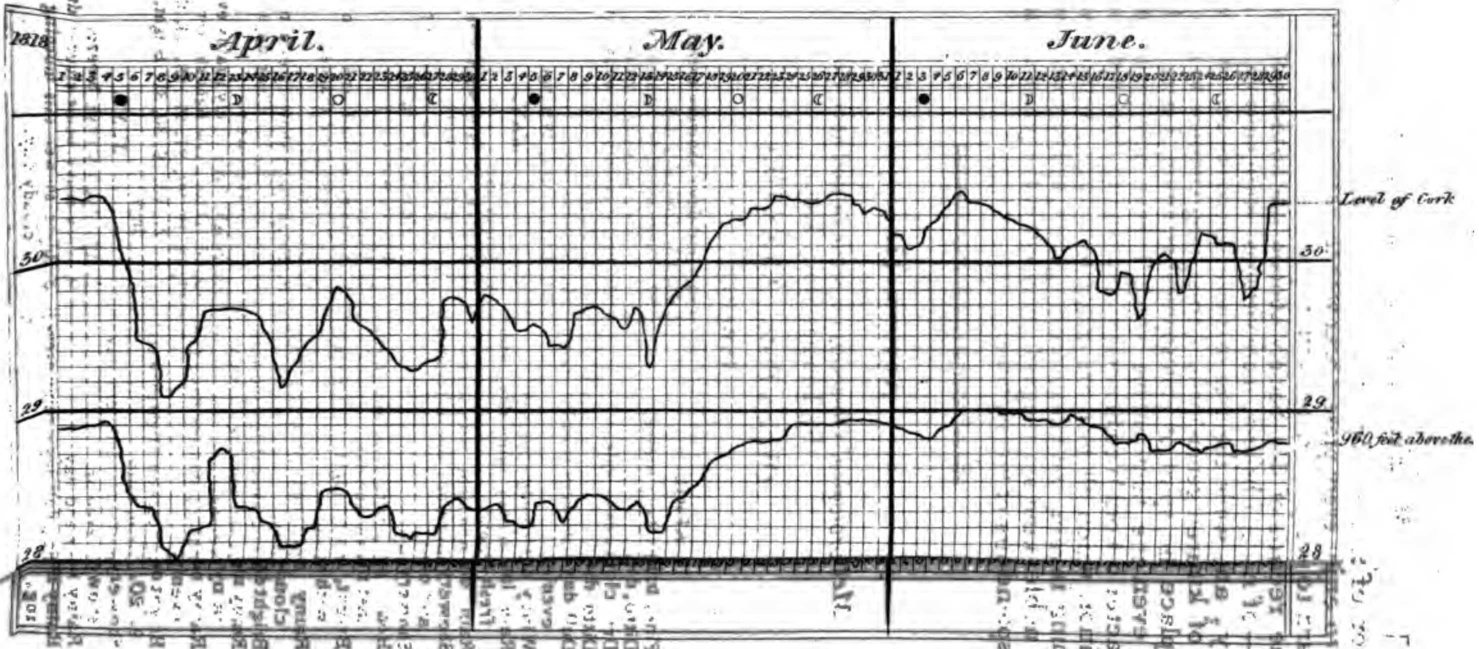
After the discharge of this last paternal duty, he retired to rest, and slept with more than his usual tranquillity, and in the morning (as the weather was fine) he ordered his carriage, and desired that it might go out on the road towards Woodhouselee. He was able to go so far as to come within sight of his own grounds; and then raising himself in the carriage, his eye was observed to kindle as he looked once more upon the hills, which he felt he was so soon to leave, "*and which he had loved so well.*" There was an influence in the scene which seemed to renew his strength, and he returned to town, and walked up the stair of his house with more vigour than he had shown for some time; but the excitement was momentary, and he had scarcely entered his study, before he sank down upon the floor, without a sigh or a groan. Medical assistance was immediately procured, but it was soon found that all assistance was vain; and Dr. Gregory arrived in time only to close his eyes, and thus to give the final testimony of a friendship, which, in the last words that he wrote for the press, Lord Woodhouselee had gratefully commemorated as having *borne the test of nearly half a century.*

His remains were interred in the family burial-place in the Grayfriars Church-yard, beside those of his father and mother, to whose memory it was then found, that his filial piety had so exclusively dedicated it, that their epitaph occupied the whole of the tablet, and no room was left for any inscription to himself.

I have very ill executed the melancholy task I have undertaken, if it is now necessary for me to conclude this account with any laboured delineation of the character of Lord Woodhouselee. I am speaking to some, in whose memories his virtues are written in better characters than those of words; and I am too conscious of the partiality of friendship, to trust myself to any other representation than that which his own life and conduct can supply. Upon his literary character it will be the province of posterity to pronounce; and to it I willingly leave to determine the rank he is to hold among the writers of his country. To us in these moments, when we are again, as it were, leaving his grave, there are other reflections that belong; and there are recollections of no vulgar kind that arise, when we review the life of which we have seen the close.

It was a life, in its first view, of usefulness and of honour. He was called to fill some of the most important offices which the constitution of human society affords,—as a father of a family,—a possessor of property,—a man of letters,—and a Judge in the Supreme Courts of his country; and he filled them all, not only with the dignity of a man of virtue, but with the grace of a man whose taste was founded upon high principles, and fashioned upon exalted models. It was a life, in its second view, of happiness as well as of honour: happy in all the social relations which time afforded him,—in the esteem of his country,—the affection of his friends,—the love and the promises of his children: happy in a temper of mind which knew no ambition but that of duty, and aspired to no distinction but that of doing good: happier than all in those early and elevated views of religion which threw their own radiance over all the scenes of

Barometer.



Engraved for Dr Thomson's Annals, for Baldwin, Cradock & Joy, Paternoster Row, Decr 1818.

man or of nature through which he passed, and which enabled him to enjoy every present hour with thankfulness, and to look forward to every future one with hope.

The records of this Society contain the histories of greater men—of none, I believe, more virtuous, more amiable, or more happy; and while the lives of these illustrious men (written by men of kindred genius) will, I trust, long continue to inspire in this place the spirit of philosophical ambition, I dare to hope, that even the faint outline which I have now given of the character of Lord Woodhouselee, may tend to cherish that *moral* ambition which all men are called to indulge; without which learning is vain, and talents are dangerous, and to which rewards of a nobler kind are assigned, than either the praise of men or the splendours of literary fame.

ARTICLE II.

Meteorological Observations made at and near Cork.

By Thomas Holt, Esq.

(With a Plate. LXXXVII.)

REMARKS.

APRIL.

1. Fine, bright day; breeze.
2. Ditto, ditto.
3. Dry, cloudy day; gale.
4. Ditto, ditto.
5. Dull day; showery from 12; rainy evening.
6. Windy and cloudy; no rain.
7. Rain last night; rainy day, with fresh breeze.
8. Rain, day and night, with wind.
9. Showery morning; fine afternoon and night.
10. Showery day.
11. Heavy gale, with frost and snow, last night; fine day.
12. Bright, frosty night; clear day, with wind.
13. Rainy night and morning; dry, cloudy day.
14. Bright day; occasional light showers.
15. Rainy night and morning; fine day; rainy evening.
16. Rainy morning; showery day; fine evening.
17. Bright day; occasional light showers.

18, 19, 20. Ditto, ditto.

21. Showery morning; dull, dry day; showery evening.
22. Rainy night and day.
23. Rainy night; dull day; rainy evening.
24. Dull day; showery evening.

25, 26. Dull, dry day.

27. Foggy morning; light showers; dull day; showery evening.
28. Bright morning; cloudy day, with showers.
29. Showery day.
30. Ditto; rainy evening.

MAY.

1. Bright day.
2. Showers of hail, with great wind and heavy rain.
3. Cloudy morning and day; rainy evening and night.
4. Bright, warm day.
5. Ditto.
6. Showers of hail and rain, with lightning and thunder.
7. Showery day.
8. Bright day; showery evening.

9, 10, 11, 12, 13. Clear days; occasional showers.

14. Bright day; windy; rainy evening.

15, 16. Ditto; few light showers.

17, 18, 19, 20, 21; 22, 23, 24, 25, 26, 27, 28, 29, 30, 31. Bright, warm days.

JUNE.

1. Cloudy, dry day; breeze.
2. Very heavy, dense clouds; dry.
3. Light shower this morning; dry, cloudy day.

4. Foggy morning; bright day; breeze.
5, 6. Bright days; breeze.
7. Bright, hot day.
8. Lightning and thunder, with heavy rain, at 11 a. m.; fine afterwards.
9, 10. Bright days; breeze.
11, 12. Bright, hot days; breeze.
13. Cloudy day; cool breeze.
14. Ditto; breeze, with rainy evening.
15. Showers last night; cloudy day.
16. Showery day; fine evening.
17. Bright day; breeze.
18. Shower at 10, a. m.; bright day; cold wind.
19, 20, 21, 22. Fine days; cold breeze and cold nights, with occasional showers.
23. Bright day; breeze.
24, 25. Ditto, ditto.
26. Showery night and morning; cloudy, dry day.
27, 28. Bright day; breeze.
29. Bright, hot day.
30. Bright morning; very hot; cloudy and cool afternoon.

RAIN.

1818.	Inches.	1818.	Inches.	1818.	Inches.
April 1		May 1		June 1	0·027
2		2	0·228	2	
3		3	0·108	3	
4		4		4	
5	0·450	5		5	
6		6	0·150	6	
7	0·504	7	0·180	7	
8	0·684	8	0·050	8	0·396
9	0·048	9		9	
10		10		10	
11	0·072	11		11	
12		12		12	
13	0·210	13	0·510	13	
14	0·018	14	0·336	14	0·008
15	0·099	15		15	0·045
16	0·516	16	0·036	16	0·015
17	0·051	17		17	0·049
18	0·009	18		18	0·158
19		19		19	0·141
20		20		20	
21		21		21	0·015
22	0·882	22		22	0·144
23	1·032	23		23	
24	0·010	24		24	
25		25		25	
26	0·090	26		26	0·042
27		27		27	
28	0·408	28		28	
29	0·054	29		29	
30	0·018	30		30	
		31			
	5·155		1·598		1·039

ARTICLE III.

Meteorological Observations made at Montreal.

THE following meteorological observations made at Montreal, during the winter of 1816 and 1817, are much at the service of the editors of the *Annals of Philosophy*. It is regretted that the register is so imperfect, the state of the barometer not being noted, and the thermometer frequently neglected; yet it is presumed that an inspection of it viewed in comparison with the subjoined tables, copied from diaries kept during the month of January, 1817, in Halifax and Boston, may not be without interest to some of your meteorological readers.

Journal of the Weather at Montreal.

Date.	Thermometer.				Wind.	Remarks.
	8 a. m.	12 n.	4 p.m.	10p.m.		
1816.						
Dec. 26	36°	40°	37°	42°	SW	Foggy; rain.
27	40	44	40	32	SSW	Gusts of wind; cloudy.
28	34	36	36	34	SW	Ditto, ditto.
29	33	30	27	19	NW	Snow and hail.
30	4	14	14	5	WNW	Clear and dry.
31	24	38	36	38	SE	Stormy.
1817.						
Jan. 1	34	40	46	41	SW	Foggy.
2	29	30	36	25	SSW	Clear and dry.
3	10	16	20	39	NE—SE	Ditto; ice on the St. Lawrence broken.
4	42	40	39	26	SE—SW	Rain; hazy; change.
5	4	8	10	12	W	Clear, dry day.
6	8	10	10	8	NE	Two inches snow fell.
7	12	18	18	12	ENE	Hazy.
8	12	22	20	18	NNW	Snow; cloudy.
9	22	32	30	30	SW	Ditto.
10	28	30	31	26	N	Ditto.
11	7	18	12	3	Ditto	Ditto.
12	– 4	– 0	– 3	–10	W	Clear and dry winds.
13	–10	4	– 0	–10	Ditto	Ditto, river closed up opposite the town of Montreal.
14	–19	– 0	3	–10	Ditto	Ditto, ditto entirely frozen; temp. a few miles up the country at 8 a.m. 22° under zero.
15	–14	– 2	– 2	– 2	NE	Cloudy.
16	– 1	14	14	10	Ditto	Crossing commenced on the ice of the river.
17	11	20	27	20	Ditto	Four inches snow.
18	20	20	20	2	SSW	Clear.
19	–11	– 6	– 6	– 0	WNW	Ditto, with much wind.
20	– 0	7	7	– 3	N	Clear.
21	– 3	8	10	– 1	W	Ditto.
22	– 1	10	8	– 2	WSW	Ditto.
23	– 8	7	3	– 0	Ditto	Ditto.
24	13	20	19	24	Ditto	Snow.
25	21	26	24	18	SSW	Cloudy.
26	8			8	Ditto	Clear and dry.
27	5	11	10	– 2	SSE	Ditto.
28	–16	– 8	– 6	– 8	W	Ditto.
29	– 8	– 0	4	– 6	WSW	Ditto.
30	– 9	– 6	– 0	– 6	Ditto	Ditto.
31	–11	– 0	– 6		W	Ditto.
Feb. 1	–13	5	6	6	N	Change; snow.
2	1	13			Ditto	Snow.
3	– 3	13	10	7	Ditto	Cloudy.
4	–12	– 6	– 8	–20	W	Clear and dry.
5	fluid in bulb	–11	–12	–20	Ditto	Ditto temp. by a corresponding thermometer in the country at seven

Date.	Thermometer.				Wind.	Remarks.
	8 a. m.	12 n.	4 p. m.	10p.m.		
1817.						
						o'clock, a. m. 31° under zero.
Feb. 6	−8°	10°	7°		Variable	
7	7	25	26	12°	Ditto	Cloudy.
8	17	26	25	10	Ditto	Snow.
9	− 6	14	20		N	Cloudy.
10	18	20	22		SW	Snow.
11	−14	− 6	− 2		W	Fair and clear.
12	−16	− 2	4	− 4	NW	Ditto.
13	4	16	14	falling	SE	Blowing, with clouds.
14	fluid in bulb	−14	13		W	Clear; temp. in country 30° under 0°.
15	−20	− 8	− 4	−14	Ditto	Ditto and fair.
16	−18	4	− 0		SW	Ditto.
17	− 2	13	14		WNW	Ditto; cloudy.
18	2	18	28		NW	Fair and bright.
19	8	28	29	36	Variable	Hazy; foggy.
20	25	42	40		SW	Ditto.
21	26	35	34		SE	Ditto snow and rain showers.
22	36	40	38		SW—S	Cumulus clouds; evening rain.
23	26	24	46		W	Clear.
24	8	12	14		NNE	Snow storm.
25	7	10	10		SW	Blowy, cloudy weather.
26	2	10	20		W	Clear and serene.
27	− 0	8	18		NNW—NE	A snow storm.
28	19	30	24		N—NE	Cloudy; heavy winds.
Mar. 1	17	22	22		N	Ditto.
2	20	24			W	Clear and fair.
3		30	36		SW	Ditto.
4	32	42	38		SSE	Cloudy; showers.
5		42	38		S	Ditto.
6	36	38	39		S—SE	Ditto, with rain.
7	39	41	32		SW	Ditto; clear.
8		30	30		SSE	Ditto, ditto.
9	..	..	..		SW	Regular thaw commences.
10		40	38		Variable	Clear; cloudy.
11	14	16	24		NW—NE	Ditto; frost succeeds again.
12	4	14	20		N	Ditto; clouds.
13	10	16	22		NE	Ditto, ditto.
14	16	28	30		NNE	Weather clear and fair.
15	20	32	36		N	Ditto.
16	20	32			Ditto	Ditto.
17	28	40	38		NE	Snow.
18	34	37	38		SE—SW	Ditto and rain.
19	8	18	14		NNW	Hazy.
20	6	16	20		SW	Ditto.
21	20	36	37		SSW	Sudden changes.
22	28	37	40		SSE	Cloudy.
23	34	40	38		Ditto	Ditto.
24	38	40	40		SE	Cloudy, hazy weather.
25	34	40	36		Variable	Fair and clear.
26	18	22	20		N	Snow.
27	23	34	32		S—SW	Ditto.
28	26	30	32		SW	Ditto.
29	22	30	35		S	Ditto.
30	24	36	32		SW	Fair, clear weather.
31	28	40	50		S	Ditto, ditto.

Diary of the Weather at Halifax, Jan. 1818.

Date.	Thermometer.				Winds.
	8 a. m.	4 p m.	10 p. m.	Average.	
Jan. 1	36°	38°	38°	37·3°	WNW—WSW
2	36	38	27	33·6	Variable
3	23	27	24	24·6	NW—N
4	38	50	56	48·0	SW
5	34	32	14	26·6	Ditto and NW
6	9	20	21	16·6	NW
7	36	33	25	31·3	Variable
8	19	23	15	19·0	N—NNE
9	13	25	30	22·6	NW
10	34	36	34	34·6	Calm
11	36	26	34	32·6	WSW
12	26	25	20	23·6	W
13	10	15	10	11·6	WNW
14	10	14	2	8·6	NNW
15	2	15	5	7·3	Ditto
16	4	13	10	9·0	NNE
17	8	20	16	14·6	Ditto
18	30	36	40	35·3	SE
19	32	22	14	22·6	WSW
20	10	12	10	10·6	NNW
21	12	23	22	19·0	Ditto—W
22	22	20	20	20·6	N by E
23	22	29	23	24·6	Ditto
24	15	25	25	21·6	Variable
25	20	19	15	18·0	N
26	23	31	29	27·6	NW—NE
27	19	21	12	17·3	N
28	4	— 0	— 8	— 4·0	NW
29	— 7	5	1	— 2·5	NNW
30	8	8	— 5	3·6	Ditto
31	— 2	15	5	6·0	NW

GENERAL OBSERVATIONS.

Average of the month.	Days.
Dull and heavy	2
Rain and wind	1
Dull weather, with snow	1
Snow	3
Wind and rain ; stormy	2
Fine and clear	22
	31
Freezing	1
Above freezing	5
Below	25
	31
Medium temperature for the month	20°
Highest	56
Lowest	— 16

which was at four o'clock, a. m. on the 29th.

Snow fell on the 8th, rain 18th, snow 25th, &c. &c. &c.

Diary of the Weather at Boston, Jan. 1818.

Date.	Thermometer.				Wind.	Weather.
	8 a.m.	2 p.m.	9 p.m.	Average.		
Jan. 1	31°	48°	39°	39·3	SSW	Clear, dry day.
2	29	48	37	41·3	W—NW	Ditto, cloudy evening.
3	28	44	40	37·3	Variable	Fog; rain.
4	55	50	44	49·6	SSW	Rain.
5	26	28	26	26·6	NW brisk	Clear; cloudy.
6	29	42	42	37·6	SW	Foggy; ditto.
7	34	44	35	37·6	Variable	Snow; cloudy.
8	32	29	26	29·0	NE—NW	Ditto; cloudy.
9	32	44	32	36·0	WSW	Clear; cloudy; rain.
10	40	42	40	40·6	SE—W	Cloudy; fog.
11	38	32	23	31·0	SW—WNW	Snow; clear.
12	19	22	16	19·0	W	Clear; fair.
13	12	24	21	19·0	Ditto	Day clear; snow.
14	14	20	12	15·3	N	Ditto.
15	11	28	24	21·0	Variable	Clear; cloudy.
16	34	28	28	30·0	NE	Snow; lightning.
17	18	27	26	37·0	Variable	Rain; thunder.
18	37	33	20	30·0	WNW high	Fog; snow.
19	12	15	10	12·3	W by N gale	Clear.
20	11	20	20	17·0	W	Clear; snow.
21	20	30	18	22·6	WNW	Clouds; clear.
22	9	20	11	13·3	NW	Serene.
23	7	26	24	19·0	Variable	Ditto; snow.
24	32	30	29	30·3	Ditto	Snow; cloudy.
25	17	32	26	25·0	W	Clear; cloudy.
26	27	30	18	25·0	SW—NW	Ditto, ditto.
27	1	6	16	7·6	NW	Fair and clear.
28	−1	7	−1	2·0	Ditto	Ditto, ditto.
29	−2	21	23	12·0	SW	Ditto, ditto.
30	5	13	3	7·0	NW	Ditto, ditto.
31	7	27	12	15·0	SW	Ditto, ditto.

ARTICLE IV.

Some Additional Observations on the Weights of the Atoms of Chemical Bodies. By Thomas Thomson, M.D. F.R.S.

(*Continued from p.* 350.)

I SHALL now proceed to give the weights of the atoms of the compound combustibles, the acids, &c. as far as the present state of our knowledge will enable us to go.

		Number of atoms.	Weight of a particle.
102	Water composed of	1 *o* + 1 *h*	1·125
103	Carbonic oxide.	1 *c* + 1 *o*	1·750
104	Carbonic acid	1 *c* + 2 *a*	2·750
105	Chlorocarbonic oxide	1 *c* + 1 *o* + 1 *ch*	6·250
106	Cyanogen	2 c + 1 a	3·250

		Number of atoms.	Weight of a particle.
107	Olefiant gas	$1\,c + 1\,h$	0·875
108	Carburetted hydrogen	$1\,c + 2\,h$	1·000
109	Chloric ether	$2\,c + 2\,h + 1\,ch$	6·250
110	Hydrocarbonic oxide	$3\,c + 3\,o + 1\,h$	5·375
111	Boracic acid	$1\,b + 2\,o$	2·875
112	Silica	$1\,s + 1\,o$	2·000
113	Hypophosphorous acid	$1\,p + 1\,o$	2·500
114	Phosphorous acid	$1\,p + 2\,o$	3·500
115	Phosphoric acid	$1\,p + 3\,o$	4·500
116	Protophosphuretted hydrogen	$1\,p + 2\,h$	1·750
117	Perphosphuretted hydrogen	$1\,p + 1\,h$	1·625
118	Protochloride of phosphorus	$1\,p + 1\,ch$	6·000
119	Perchloride of phosphorus	$1\,p + 2\,ch$	10·500
120	Phosphuret of carbon	$1\,p + 1\,c$	2·250
121	Hyposulphurous acid[a]	$1\,s + 1\,o$	3·000
122	Sulphurous acid	$1\,s + 2\,o$	4·000
123	Sulphuric acid	$1\,s + 3\,o$	5·000
124	Chloride of sulphur	$1\,s + 1\,ch$	6·500
125	Sulphuretted hydrogen	$1\,s + 1\,h$	2·125
126	Sulphuret of carbon	$2\,s + 1\,c$	4·750
127	Sulphuret of phosphorus	$1\,s + 1\,p?$	3·500 ?
128	Arsenious acid	$1\,a + 1{\cdot}5\,o$	6·250
129	Arsenic acid	$1\,a + 2{\cdot}5\,o$	7·250
130	Choride of arsenic	$1\,a + 1{\cdot}5\,ch$	11·500
131	Sulphuret of arsenic	$1\,a + 2\,s?$	8·750 ?
132	Oxide of tellurium	$1\,t + 1\,o$	5·000
133	Telluretted hydrogen	$1\,t + 1\,h?$	4·125 ?
134	Protoxide of azote	$1\,a + 1\,o$	2·750
135	Deutoxide of azote	$1\,a + 2\,o$	3·750
136	Hyponitrous acid	$1\,a + 3\,o$	4·750
137	Nitrous acid	$1\,a + 4\,o$	5·750

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[a] This acid is formed when zinc or iron is dissolved in sulphurous acid. The salt obtained used to be called a *sulphuretted sulphite*. I conceive that I was the first person who pointed it out as a peculiar acid in the fifth edition of my System of Chemistry. Gay-Lussac assures us that he had recognized its existence before me; but I am not aware of any publication of his in which the fact was mentioned previous to the appearance of my work. The composition of hyposulphurous acid is easily deduced from the action of sulphurous acid on zinc or iron. One half of the oxygen in the acid must go to the oxidizement of the zinc or the iron. Of course the acid which unites with these oxides must be composed of sulphur united with one half as much oxygen as exists in sulphurous acid, that is to say, the acid must be a compound of 1 atom sulphur + 1 atom oxygen.

		Number of atoms.	Weight of a particle.
138	Nitric acid.	1 *a* + 5 *o*	6·750
139	Chloride of azote	1 *a* + 4 *ch*	19·750
140	Sulphuret of potassium.	1 *p* + 1 *s*	7·000
141	Sulphuret of sodium.	1 *so* + 1 *s*	5·000
142	Protosulphuret of iron	1 *i* + 1 *s*	5·500
143	Persulphuret of iron.	1 *i* + 2 *s*	7·500
144	Sulphuret of cobalt	1 *c* + 1 *s*	5·625
145	Sulphuret of zinc	1 *z* + 1 *s*	6·125
146	Protosulphuret of bismuth	1 *b* + 1 *s*	10·875
147	Persulphuret of bismuth	1 *b* + 2 *s*	12·875
148	Protosulphuret of lead.	1 *l* + 1 *s*	15·000
149	Persulphuret of lead	1 *l* + 2 *s*	17·000
150	Protosulphuret of tin	1 *t* + 1 *s*	9·375
151	Persulphuret of tin	1 *t* + 2 *s*	11·375
152	Sulphuret of copper.	1 *c* + 1 *s*	10·000
153	Protosulphuret of mercury	1 *m* + 1 *s*	27·000
154	Persulphuret of mercury	1 *m* + 2 *s*	29·000
155	Sulphuret of silver.	1 *si* + 1 *s*	15·750
156	Sulphuret of gold.	1 *g* + 1 *s*	11·250
157	Sulphuret of palladium.	1 *p* + 1 *s*	9·000
158	Oxalic acid.	0 *h* + 2 *c* + 3 *o*	4·500
159	Formic acid	1 *h* + 2 *c* + 3 *o*	4·625
160	Mellitic acid	1 *h* + 4 *c* + 3 *o*	6·125
161	Succinic acid	2 *h* + 4 *c* + 3 *o*	6·250
162	Acetic acid.	3 *h* + 4 *c* + 3 *o*	6·375
163	Citric acid	3 *h* + 4 *c* + 4 *o*	7·375
164	Tartaric acid	3 *h* + 4 *c* + 5 *o*	8·375
165	Gallic acid.	3 *h* + 6 *c* + 3 *o*	7·875
166	Tannin.	3 *h* + 6 *c* + 4 *o*	8·875
167	Saclactic acid.	5 *h* + 6 *c* + 8 *o*	13·125
168	Benzoic acid	6 *h* + 15 *c* + 3 *o*	15·000[b]

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[b] These numbers are the results of the analyses of Berzelius, with the exception of oxalic acid. Berzelius states the amount of the hydrogen in this acid at $\frac{1}{12}$th of an atom. It being obvious that such a combination cannot exist, I have left out the hydrogen till the point can be more accurately determined.

It is scarcely necessary to remark that the mere knowledge of the number of atoms of which a vegetable body is composed cannot lead to an accurate idea of its constitution. The probability is that these atoms do not unite altogether to form the vegetable body in question; but that they enter in the first place into binary or ternary combinations, and that these primary compounds, by uniting with each other, form the vegetable substance in question. Thus we may conceive oxalic acid to be a compound of one atom of carbonic oxide with one atom of car-

		Number of atoms.	Weight of a particle.
169	Muriatic acid	$1\,h + 1\,ch$	4·625
170	Chloric acid	$1\,ch + 5\,o$	9·500
171	Protoxide of chlorine	$1\,ch + 1\,o$	5·500
172	Deutoxide of chlorine	$1\,ch + 2\,o$	6·500
173	Hydriodic acid	$1\,h + 1\,i$	15·750
174	Iodic acid	$1\,i + 5\,o$	20·625
175	Chloriodic acid	$1\,i + 2\,ch$?	24·625?
176	Hydrocyanic acid	$1\,cy + 1\,h$	3·375
177	Alcohol	2 olefiant gas + 1 water	2·875
178	Sulphuric ether	4 olefiant gas + 1 water?	4·625?

bonic acid. It is even possible that 12 of these compound atoms may unite with one atom of hydrogen, which would constitute the oxalic acid of Berzelius. On that supposition the symbol for oxalic acid would be 12 ((1 *c* + 1 *o*) + (1 *c* + 2 *o*)) + 1 *h*. To give another illustration, we may suppose tartaric acid to be a compound of 1 atom carburetted hydron + 1 atom water + 1 atom carbonic acid + 2 atoms carbonic oxide; for these binary compounds would exhaust the atoms of which tartaric acid is composed.

1 atom carburetted hydrogen	$2\,h$	$+ 1\,c$	$+ 0\,o$
1 atom water	$1\,h$	$+ 0\,c$	$+ 1\,o$
1 atom carbonic acid	$0\,h$	$+ 1\,c$	$+ 2\,o$
2 atoms carbonic oxide	$0\,h$	$+ 2\,c$	$+ 2\,o$
	3	+ 4	+ 5

Or we may suppose it formed by the union of

2 atoms olefiant gas	$2\,h$	$+ 2\,c$	
2 atoms carbonic acid	0	$+ 2\,c$	$+ 4\,o$
1 atom water	1	+ 0	$+ 1\,o$
	3	+ 4	+ 5

And various other suppositions may be formed. Now as hitherto no method has been devised to determine the nature and number of primary compounds of which vegetable bodies are formed, it is obvious that the mere knowledge of their elements can lead to no very satisfactory conclusions respecting their nature. It is even possible for two vegetable substances to be composed of the very same number of atoms of hydrogen, carbon, and oxygen, and yet to possess quite different properties; because the primary compounds formed by these atoms are different in each. The analysis, however, of vegetable acids is of considerable importance; because it gives us their weight, and of course the proportion in which they unite with the bases.

		Number of atoms.	Weight of a particle.
179	Nitric ether ..	4 olefiant gas + 1 nitric acid?	10·250?
180	Chloric ether. .	2 olefiant gas + 1 chlorine .	6·250
181	Muriatic ether.	4 olefiant gas + 1 muriatic acid?	8·125?
182	Hydriodic ether	4 olefiant gas + 1 hydriodic acid?	19·250?
183	Acetic ether ..	4 olefiant gas + 1 acetic acid?	9·875?
184	Formic ether ..	4 olefiant gas + 1 formic acid?	8·125?
185	Olive oil.........	11 *h* + 10 *c* + 1 *o*	9·875
186	Bees-wax.	18 *h* + 20 *c* + 1 *o*	18·250
187	Rosin	13 *h* + 15 *c* + 2 *o*	14·875
188	Copal............	18 *h* + 19 *c* + 2 *o*	18·500
189	Woody fibre.	4 *h* + 7 *c* + 4 *o*	9·750
190	Starch sugar.	5 *h* + 5 *c* + 5 *o*	9·375
191	Common sugar. ..	5 *h* + 6 *c* + 5 *o*	10·125
192	Gum arabic	6 *h* + 6 *c* + 6 *o*	11·250
193	Starch..........	10 *h* + 10 *c* + 9 *o*	17·750
194	Gelatin	14 *h* + 15 *c* + 6 *o* + 2 *a*	22·500
195	Albumen......	13 *h* + 17 *c* + 6 *o* + 2 *a*	23·875
196	Fibrin........	14 *h* + 18 *c* + 5 *o* + 3 *a*	25·500

As we are ignorant of the weight of the last 20 bodies which are capable of uniting with a given weight of any other compound, it is obvious that we have no means of determining the weight of an integrant particle of them. The numbers in the table represent the weights of the smallest number of atoms which agree with the analysis of each. If these analyses approach the truth, it is obvious that an integrant particle of each of these bodies must be either the number given in the table, or some multiple of that number, as two, three, four times the number. These analyses may be of some service in directing the attention of chemists towards the kind of binary compound of the union of which these bodies may be supposed to consist. But it would be a mistake to consider the second column of the table as representing the real constitution of the vegetable and animal bodies subjected to analysis.

I shall now proceed to give an example or two of the constitution of the salts. It would be unnecessary to give complete tables of all the salts, because their composition may be readily conceived by considering each neutral salt as a combination of one atom acid and one atom base.

Sulphates.

		Atoms of acid, base, and water.	Weight of a particle.*
197	Sulphate of ammonia	1 *s* + 1 *a* + 3 water	7·125
198	Sulphate of potash	1 *s* + 1 *p*	11·000

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* *The water is not included in this weight. The reader may easily supply the deficiency.*

		Atoms of acid, base, and water.	Weight of a particle.
199	Bisulphate of potash	2 *s* + 1 *p*	16·000
200	Sulphate of soda	1 *s* + 1 *s* + 10 water	9·000
201	Hydrous sulphate of lime.	1 *s* + 1 *l* + 2 water	8·625
202	Anhydrous sulphate of lime	1 *s* + 1 *l*	
203	Sulphate of barytes	1 *s* + 1 *b*	14·750
204	Bisulphate of barytes	2 *s* + 1 *b*	19·750
205	Sulphate of strontian	1 *s* + 1 *str*	11·500
206	Sulphate of magnesia	1 *s* + 1 *m* + 5 water	7·500
207	Sulphate of glucina	1 *s* + 1 *gl*	8·250
208	Bisulphate of glucina	2 *s* + 1 *gl*	13·250
209	Subsesquisulphate of glucina	2 *s* + 3 *gh*	19·750
210	Sulphate of alumina	1 *s* + 1 *a*	7·125
211	Sulphate of iron	1 *s* + 1 *i* + 7 water	9·500
212	Persulphate of iron	1 *s* + 1 *i*	15·000
213	Tripersulphate of iron.	3 *s* + 1 *i*	25·000
214	Sub-bipersulphate of iron	1 *s* + 2 *i*	25·000
215	Sulphate of nickel	1 *s* + 1 *n* + 7 water	9·375
216	Sulphate of cobalt	1 *s* + 1 *c* + 7 water	9·625
217	Sulphate of manganese	1 *s* + 1 *m* + 5 water	9·500
218	Sulphate of zinc	1 *s* + 1 *z* + 5 water	10·125
219	Sulphate of lead	1 *s* + 1 *l*	19·000
220	Bisulphate of copper	2 *s* + 1 *c* + 10 water	20·000
221	Subsulphate of copper.	2 *s* + 3 *c* + 6 water	40·000
222	Sulphate of bismuth	1 *s* + 1 *b*	14·875
223	Subsulphate of bismuth	1 *s* + 3 *b*	34·625
224	Sulphate of mercury	1 *s* + 1 *m*	31·000
225	Turpeth mineral, or persulphate of mercury	1 *s* + 1 *m*	32·000
226	Bipersulphate of mercury.	2 *s* + 1 *m*	37·000
227	Sulphate of silver.	1 *s* + 1 *si*	19·750
228	Sulphate of platinum	1 *s* + 1 *pl*	28·625

ARTICLE V.

On the Action of Sulphurous Acid Gas on Sulphuretted Hydrogen Gas. By Thomas Thomson, M.D. F.R.S.

It was first observed by Mr. Kirwan, that when sulphuretted hydrogen gas was mixed with sulphurous acid gas, the bulk of the two gases diminishes, and a quantity of sulphur is deposited on the sides of the jar. He found that five measures of sulphurous acid and six measures of sulphuretted hydrogen, when thus mixed, were reduced to three measures.* On turning to Messrs.

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* Phil. Trans. 1786, p. 118.

Aiken's Dictionary of Chemistry and Mineralogy, published in 1807, I find exactly the same experiments related as those previously given by Kirwan in his paper "On Hepatic Air." I conceive, therefore, that these gentlemen did not make any experiments on the subject themselves; but simply adopted Mr. Kirwan's results; though the want of a reference to that gentleman might at first lead to the notion that the experiments related were their own. Thenard, in his "Traité de Chimie," vol. i. p. 539, informs us, that the action of sulphurous acid gas on sulphuretted hydrogen gas has been fully examined: that the two gases decompose each other reciprocally, and form water and sulphur; that the action is instantaneous, if the gases be moist; but very slow if they be dry; and that rather more than two parts of sulphuretted hydrogen are requisite to decompose one part of sulphurous acid.

These were all the circumstances respecting the action of these two gases on each other which I could find in chemical books at the time that I was employed in preparing the fifth edition of my System of Chemistry for the press. As they did not appear at all satisfactory, I found myself under the necessity of omitting all attempts to explain this action in my System, and to place the fact among the list of subjects which required further investigation; of which I found myself under the necessity of drawing up a pretty copious list. These topics I propose to investigate in succession; and I shall lay the result of my experiments occasionally before the readers of the *Annals of Philosophy*.

The gases employed by Kirwan were probably not absolutely pure. He did not examine with sufficient care the volumes of the two gases requisite to produce the greatest condensation; nor is his account of the properties of the residual gas sufficient to enable us to understand its nature. There is the same want of precision in the account given by Thenard. According to him, rather more than two volumes of sulphuretted hydrogen are decomposed by one volume of sulphurous acid gas, and the result is water and sulphur. In these two gases the weight of the atom is just double the specific gravity (supposing the specific gravity of oxygen gas to be unity). We may, therefore, substitute atom for volume.

	Sulphur	Atoms.
2 atoms sulphuretted hydrogen contain ..	2 atoms	+ 2 hydrogen
2 atom sulphurous acid contains.	1	+ 2 oxygen

From this it is obvious, that if the two gases decompose each other, and form water and sulphur, they will be completely condensed when we mix two volumes of sulphuretted hydrogen with one volume of sulphurous acid—proportions which do not tally completely with the statement of Thenard.

On repeating the experiment over mercury with gases perfectly pure and sufficiently dry, I found that the two gases are completely condensed; and lose their gaseous state entirely, when we mix three volumes of sulphuretted hydrogen gas with two volumes of sulphurous acid gas. Two volumes of the former, when mixed with one of the latter gas, did not undergo complete condensation. The substance formed was quite dry; and I could not separate any moisture from it by the application of heat, or by any other method which I could think of. Hence we have no experimental proof of the formation of water; nor is theory more favourable to the notion. Let us substitute, as before, atom for volume, that we may judge of the elements which have acted on each other.

	Atoms.	Atoms.
3 atoms of sulph. hydrogen contain. ..	3 sulphur	+ 3 hydrogen
2 atoms sulphurous acid contain	2 sulphur	+ 4 oxygen

So that there are present three atoms of hydrogen and four atoms of oxygen. Were these bodies to unite and form water, it is obvious that there would remain one atom of oxygen gas uncombined, which would amount in bulk to the fourth part of the sulphurous acid gas, or half a volume. In my experiment I mixed over mercury 12 cubic inches of sulphuretted hydrogen with eight cubic inches of oxygen gas. If Thenard's statement were accurate, namely, that water is formed during the action of these two gases on each other, the residual oxygen gas would have amounted to two cubic inches; whereas there was no residue, except an insignificant bubble of common air not larger than a pea.

I think after the preceding detail there cannot be a doubt that the hypothesis of Thenard, that, when these two gases are mixed, they are converted into water and sulphur, is inaccurate. In reality, the two gases unite together and form a compound, which has hitherto been mistaken for sulphur, though it possesses properties somewhat different from that combustible substance.

Its colour is orange-yellow, without any mixture of the greenish tinge which distinguishes sulphur. It is not tasteless, like sulphur, but gives a sensibly acid impression to the tongue: this impression becomes at last hot, or peppery, and continues in the mouth for a considerable time. When the dry compound is applied to paper stained blue with litmus, it does not produce any sensible change on it; but if we moisten the paper ever so little, it is immediately rendered red by it. Hence I conceive that this compound possesses acid properties. But it is an acid that cannot be applied to any useful purpose in chemistry, as it is decomposed by all liquid bodies that I have tried; namely, water, alcohol, nitric acid, sulphuric acid; and as it does not sensibly unite with the salifiable bases when presented in a dry state. The acid which gives the red tinge to vegetable blues is neither the sulphuric nor sulphurous; for when the compound is agitated in barytes water, no immediate precipitate takes place; though if we boil the mixture, a dirty grey precipitate at last falls.

When the compound is heated, it becomes soft and ductile; but requires for fusion a higher temperature than sulphur. But if the heat be continued, a kind of effervescence takes place, and the compound is converted into common sulphur, which burns in the usual manner.

When the compound is agitated with water, that liquid becomes milky, acquires a slightly acidulous taste, and a quantity of common sulphur is speedily deposited. The very same decomposition is produced by alcohol.

With potash it does not combine unless water be present, and in that case nothing is formed but common sulphuret of potash.

I have tried the action of various other re-agents upon this compound; but the phenomena presented were so little remarkable that they seem scarcely entitled to be related.

This is, perhaps, the first acid compound hitherto observed which contains both oxygen and hydrogen united to a combustible basis. Though of little importance in a practical point of view, it is of some little value as far as the theory is concerned; for it possesses the properties of acidity in a very weak degree; so much so that I have not been able to succeed in uniting it with any salifiable basis. This, I think, is a sufficient proof that Dr. Murray's notion, that the greatest degree of acidity is given to bodies by the joint union of oxygen and hydrogen, is not countenanced by chemical facts, nor consistent with the phenomena of the science.

I have not given this new compound a name, because it is not likely ever to be employed for any useful purpose. Perhaps the term *hydrosulphurous acid*, though not quite correct, might be applied to it without much impropriety.

Article VI.

On the Vis Viva. By Mr. John Dalton.

(To Dr. Thomson.)

RESPECTED FRIEND, *Manchester, Oct. 12, 1818.*

In the Annales de Chimie et de Physique for last July, there is a paper by M. Petit on the employment of the principle of the *vis viva* in the calculation of the effects of machines.

M. Petit expresses his surprise that so little attention has hitherto been paid to this principle, which he considers to be *capable* of general and highly interesting application. He observes, the theory of machines considered with reference to this principle requires to be almost formed anew. You will probably recollect a paper "On the Measure of Moving Force," by Mr. Ewart in the second volume (second series) of the Memoirs of the Manchester Society, which was read Nov. 18, 1808. This paper was reprinted by Mr. Nicholson in the 36th vol. of his journal, and it was also reprinted about the same time in the Repertory of Arts. You noticed it yourself in the *Annals of Philosophy*, vol. i. p. 462, and again briefly in your review of the progress of science during the year 1813, in vol. iii. of the *Annals*, p. 8. Excepting these, I do not know that any other public notice has been taken of this paper.

I fully accord with M. Petit that our elementary treatises on mechanics are extremely defective in developing the principles of moving force, and in their application to explain the action of machines. The object of this letter is to recommend to M. Petit, and to others who may be interested in the subject, to peruse the above-mentioned essay. Mr. Ewart has pointed out the source of numerous errors and inconsistencies in some of the best writers on mechanics, and has, I think, succeeded in giving satisfactory explanations of various cases (especially those in which moving force is expended in producing change of figure), which were before involved in much obscurity.

In estimating the power communicated by a stream of water to an under-shot water-wheel, M. Petit gives the same result which Mr. Ewart has given (p. 231), when supposing it to act in a similar manner; and they agree also in their statement of the maximum effect of the reaction of water in the machine known by the name of Barker's Mill, supposing the waters to issue with the velocity due to the pressure. If M. Petit has not seen Mr. Ewart's paper, their agreement in these results is the more remarkable; as I believe they are different from those obtained by all other writers who have attempted solutions of the same cases. The investigation of both these cases, however, appears to have been pursued considerably further by Mr. Ewart than by M. Petit: and he has corroborated his conclusions by some original and ably conducted experiments.

I remain, yours truly,

JOHN DALTON.

ARTICLE VII.

ANALYSES OF BOOKS.

Philosophical Transactions of the Royal Society of London for the Year 1818. *Part I.*

This part contains the following papers:

I. *On the great Strength given to Ships of War by the Application of diagonal Braces.* By Robert Seppings, Esq. F.R.S.

—Mr. Seppings begins his paper by assuring the society that the principle of applying a diagonal frame-work to ships of war had, as far as he knows, never been so applied either theoretically or practically either in this or any other maritime country till he introduced it in the year 1805. The object of the paper is to state an experiment upon the Justitia, an old Danish 74, which was ordered to be broken up in 1817 on account of her defective state. Mr. Seppings got a certain number of trusses to be placed in the hold and the port-holes of this old ship, in order to ascertain what the effect of these trusses would be when the vessel was again floated. The experiment was successful. The report of the committee of Portsmouth officers, which is given in the paper, is exceedingly favourable to the trussing system. The Howe, of 120 guns, which was built according to this system, when launched was found to have altered only 3¼ inches from her original sheer; while the Nelson and the St. Vincent, both of the same size, but built according to the old system, altered, the first 9¼ inches, and the last 9¼ inches. The report of the ship Albion (built on the new plan), after the battle of Algiers, was equally favourable. The Northumberland of 80 guns was laid on one side fore and aft, on the other side diagonally. After she conveyed Bonaparte to St. Helena, the fore and aft side required caulking, the diagonal side did not.

II. *A Memoir on the Geography of the north-eastern Part of Asia, and on the Question whether Asia and America are contiguous, or are separated by the Sea.* By Capt. James Burney, F.R.S.—The object of this memoir is to show that there is no evidence that Asia and America are separated from each other by the sea; but that all the facts at present known concur to prove that the two continents are united together. It was Muller, it seems, who first affirmed that the two continents were separated by a narrow sea, and his opinion has been universally adopted. Capt. Burney shows that no person has hitherto sailed round the north-east coast of Asia. According to him, the Russian navigators had never been able to double the promontory called on that account *swiato noss* (*sacred promontory*). But they were accustomed to construct vessels in such a manner that they could be with ease taken to pieces; they were carried across the land till they came to the sea, and then put together again. I do not see, however, any evidence which Capt. Burney has actually produced that Deschnew, upon whose voyage Muller's opinion is founded, really transported his ships or boats over land to the sea of Kamschatka. Capt. Burney's own opinion was founded upon two facts which he observed when he accompanied Capt. Cook in his last voyage to Behring's Straits. These were, the disappearing of the tides and the sea becoming shallower. These two facts indicated, he thinks, that the vessel had got into an inland sea. But, perhaps, it would be rather hazardous to consider these facts as decisive of the point. If the whole surface of the sea to the north of Behring's Straits was frozen, probably the ice might have just as great an effect in destroying the tides as land would have. The shallowness of the Frozen Ocean seems to be greater, according to the observation of Capt. Ross, at a distance from land than in its immediate neighbourhood. Upon the whole, this point of geography does not seem to be fully decided. Are we to hope for a full decision of it from the voyage of discovery made last summer under the command of Capt. Ross.

III. *Additional Facts respecting the fossil Remains of an Animal, on the Subject of which two Papers have been printed in the Philosophical Transactions, showing that the Bones of the Sternum resemble those of the Ornithorhynchus Paradoxus.* By Sir Everard Home, Bart. V.P.R.S.—The author had been favoured with several new specimens of the fossil bones of this unknown animal by the Rev. Peter Hawker, of Woodchester rectory, Minchinhampton, and Dr. Carpenter, of Lyme. He has been enabled in consequence to ascertain a strong resemblance in the bones of the sternum to the ornithorhynchus paradoxus. He has satisfied himself that the animal must have breathed air, and that it must have lived constantly in the water.

IV. *An Account of Experiments for determining the Length of the Pendulum vibrating Seconds in the Latitude of London.* By Capt. Henry Kater, F.R.S.—This interesting experiment has fortunately fallen into the hands of a gentleman whose sagacity and experimental skill have enabled him to do full justice to the subject: hence there is every reason to be satisfied that the result obtained is exceedingly near the truth. His mode of experimenting was founded upon the known fact that the centres of suspension and oscillation are reciprocal. He made these two points alternately the points of suspension, and by shifting a moveable weight rendered the number of oscillations the same in equal times in both cases. The pendulum consisted of a bar of platinum with three moveable weights. It moved upon a knife edge. A minute account is given of the structure of this instrument, of the mode of estimating the vibrations and measuring the length of the pendulum. But for all this, we must refer to the paper itself. The general result of the whole is, that a pendulum vibrating seconds in vacuo at the level of the sea, at the temperature of 62° Fahrenheit, in the north latitude of 51° 31′ 8·4″, has the following length:

	Inches.
By Sir George Shuckburgh's standard.	39·13860
By Gen. Roy's standard.	39·13717
By Bird's parliamentary standard.	39·13842

Sir George Shuckburgh's standard is preferred by Capt. Kater. Bouguer found the length of the second's pendulum at the equator 38·9949 English inches. It appears from Dr. Maskelyne's experiments (Phil. Trans. 1762, p. 434), that the length of the second's pendulum at St. Helena, lat. 15° 55′ S. is 39·04255 inches; for Dr. Maskelyne found the length of the pendulum at Greenwich to that at St. Helena as 10·0246 to 10.

V. *On the Length of the French Metre estimated in Parts of the English Standard.* By Capt. Kater, F.R.S.—The result of a very careful measurement by Capt. Kater is, that the length of the metre is 39·37079 inches of Sir George Shuckburgh's standard scale.

VI. *A few Facts relative to the colouring Matters of some Vegetables.* By James Smithson, Esq. F.R.S.—The author refutes an assertion of Fourcroy that turnsol is essentially of a red colour, and that it contains carbonate of soda. The infusion of turnsol contains no alkali, lime, nor acid, and its natural colour is blue. When the colouring matter of turnsol is burned, it leaves a saline matter which, with nitric acid, forms nitrate of potash. Mr. Smithson suspects that this colouring matter, like ulmin, is a compound of a vegetable substance and potash. The paper contains experiments on the colouring matter of the violet, sugar-loaf paper, the black mulberry, the corn poppy, sap-green, and some animal greens; but they are of so unconnected a kind that they are scarcely susceptible of abridgement. We must, therefore, refer our readers to the paper itself.

VII. *Account of Experiments made on the Strength of Materials.* By George Rennie, Jun. Esq.—These experiments differ a good deal from others of a similar kind given by former experimenters. Mr. Rennie found a cubical inch of the following bodies crushed by the following weights:

	lbs. av.
Elm	1284
American pine	1606
White deal	1928
English oak	3860
Ditto of five inches long slipped with	2572
Ditto of four inches ditto	5147
A prism of Portland stone two inches long	805
Ditto statuary marble	3216
Craig Leith stone	8688

Cubes of 1½ inch.

	Sp. gr.	
Chalk	—	1127
Brick of a pale red colour	2·085	1265
Roe stone, Gloucestershire	—	1449
Red brick, mean of two trials	2·168	1817
Yellow face baked Hammersmith paviors three times	—	2254
Burnt ditto, mean of two trials	—	3243
Stourbridge, or fine brick	—	3864
Derby grit, a red friable sandstone	2·316	7070

	Sp. gr.	lb. av.
Derby grit from another quarry	2·428	9776
Killaly white freestone, not stratified	2·423	10264
Portland	2·428	10284
Craigleith, white freestone	2·452	12346
Yorkshire paving, with the strata	2·507	12856
Ditto, against the strata	2·507	12856
White statuary marble, not veined	2·760	13632
Bramley Fall sandstone, near Leeds, with strata	2·506	13632
Ditto against strata	2·506	13632
Cornish granite	2·662	14302
Dundee sandstone, or breccia, two kinds	2·530	14918
A two inch cube of Portland	2·423	14918
Craig Leith, with strata	2·452	15560
Devonshire red marble, variegated	—	16712
Compact limestone	2·584	17354
Peterhead granite, hard close-grained	—	18636
Black compact limestone, Limerick	2·598	19924
Purbeck	2·599	20610
Black Brabant marble	2·697	20742
Very hard freestone	2·528	21254
White Italian veined marble	2·726	21783
Aberdeen granite, blue kind	2·625	24556

Cubes of different metals of ¼th inch were crushed by the following weights:

Cast iron	9773
Cast copper	7318
Fine yellow brass	10304
Wrought copper	6440
Cast tin	966
Cast lead	483

Bars of different metals six inches long and a quarter of an inch square were suspended by nippers and broken by the following weights:

Cast iron, horizontal	1166
Ditto, vertical	1218
Cast steel previously tilted	8391
Blistered steel reduced by the hammer	8322
Shear steel ditto	7977
Swedish iron ditto	4504
English iron ditto	3492
Hard gun metal, mean of two trials	2273
Wrought copper reduced by hammer	2112
Cast copper	1192
Fine yellow brass	1123
Cast tin	296
Cast lead	114

For the experiments on the twist of bars, we must refer to the paper.

The strengths of Swedish and English iron do not bear the same proportion to each other in these experiments that they do when we compare the trials of Count Sickingen with those made at Woolwich, of which an account was given in the *Annals of Philosophy*, vii. 320. From that comparison, the proportional strengths were as follows:

English iron	348·38
Swedish iron	549·25

But from Mr. Rennie's experiments, the proportional strengths are:

English iron	348·38
Swedish iron	449·34

A very material difference, which ought to be attended to.

VIII. *On the Office of the Heart-wood of Trees.* By T. A. Knight, Esq. F.R.S.—It is sufficiently known that the trunk of trees, after a certain age, is divided into two distinct substances, called the *alburnum* and the *heart-wood*. The alburnum is next the bark; it is softer, looser in its texture, and lighter coloured than the heart-wood. Some physiologists have supposed the heart-wood to be dead vegetable matter. But Mr. Knight has always combated this opinion. The object of the present paper is to prove that heart-wood, as well as the alburnum, serves as a reservoir of nourishment which the tree lays up before winter. This nourishment is employed in the following spring in forming the foliage of the plant.

IX. *On circulating Functions, and on the Integration of a Class of Equations of finite Differences into which they enter as Co-efficients.* By John F. W. Herschell, Esq. F.R.S.—As this paper is incapable of abridgement, we must refer the mathematical reader who wishes to study it to the volume of the Transactions itself.

X. *On the Fallacy of the Experiments in which Water is said to have been formed by the Decomposition of Chlorine.* By Sir H. Davy, LL.D. F.R.S. The object of this paper is to show that the water formed in Dr. Ure's experiments, of which an account was given in the last number of the *Annals*, was owing to the hydrogen evolved by the union of the chlorine with the metals combining with the oxygen of the litharge and alkali of the glass, or with the oxygen gas, which happened to be present in the tubes during the experiments. Of course the consequences deduced by Dr. Ure from his experiments are fallacious.

XI. *The Croonian Lecture. On the Changes the Blood undergoes in the Act of Coagulation.* By Sir Everard Home, Bart. V.P.R.S.—The author of this lecture is of opinion that the single muscular fibres (if the expression be allowable) are composed of the globules of the blood, which he says have an attraction for each other, and unite in long strings when deprived of their colouring matter. Blood, he says, contains carbonic acid gas. This gas, after the coagulation, endeavours to make its escape, and in this endeavour renders the coagulated blood vascular by drilling channels through it in every direction. Has the author of this hypothesis made any observations to determine whether the globules all disappear when the blood coagulates? If they do not, where is the proof that the muscular fibres are composed of the white globules?

XII. *Some Additions to the Croonian Lecture on the Changes the Blood undergoes in the Act of Coagulation.* By Sir E. Home, Bart.—One object of this appendix is to state the real diameter of a globule of the blood as measured by Capt. Kater and Dr. Wollaston. These gentlemen made it at an average $\frac{1}{5000}$th of an inch. Another object is to explain in what way it is possible for carbonic acid gas, by its efforts to escape, to render coagulated blood vascular. I have read over this explanation, but cannot say that I understand it, or that I have been able to form to myself an idea of the mechanism of the process.

XIII. *On the Laws of Polarisation and Double Refraction in regularly crystallized Bodies.* By David Brewster, LL.D. F.R.S. Lond. and Edin.—This is a very curious and valuable paper; though scarcely of a nature to be rendered intelligible without figures. The author has examined all the crystals which he has been able to procure, and has found no fewer than 165 species capable of refracting doubly. He shows that Biot's division of doubly refracting crystals into positive and negative is merely hypothetical. Some crystals have only one axis of polarisation, some two, and some three. This number of axes is connected with the primitive form of the crystals. All those having one axis have for their primitive form the regular six-sided prism, a rhomboid with an obtuse summit, or an octahedron in which the pyramids have a square base. All the crystals with three axes have the cube, the regular octahedron, or the rhomboidal dodecahedron, for the primitive form; while all the other primitive forms belong to crystals having two axes. I shall in a subsequent number of the *Annals of Philosophy* give a list of the crystals which Dr. Brewster found to refract doubly, and one or two other particulars contained in this paper which may be useful to the mineralogist. At present we have not room to spare for these particulars.

Article VIII.

Proceedings of Philosophical Societies.

ROYAL SOCIETY.

Nov. 5.—The Croonian lecture was read by Sir Everard Home. The subject was the conversion of pus into granulations of new flesh. The object of the author was to show that granulations which appear to consist of a congeries of tortuous vessels, are formed in a manner very similar to the blood vessels, &c. described by him in a former paper.[*] Pus, according to Sir E., when first secreted, is a transparent fluid. A pellicle of pus in this state covers the little prominences of the granulations. Under this pellicle particles of air are exuded, upon which vessels appear to be moulded. These vessels soon become distended with red blood. They anastomose freely, and chiefly lie horizontally, though minute red spots are also apparent, which seem to be the terminations of vessels running in a perpendicular direction. The air exuded, and upon which the vessels are formed, Sir E. considers, as in former instances, to be carbonic acid gas.

Drawings, illustrative of these and the subsequent changes, made chiefly from the observations of Mr. Bauer, accompanied the paper.

Nov. 12.—A paper, by Dr. Brewster, "On the Laws which regulate the Absorption of Polarised Light by Doubly Refracting Crystals," was read. The author was led to investigate these laws, by observing the phenomena presented by the acetate of copper when exposed to polarised light. The first section of his paper treated of the absorption of polarised light by crystals of one axis, and contained the details of a great number of observations. Crystals having more than one axis were afterwards submitted to similar experiments; and the paper concluded with remarks upon the effects of heat in modifying the absorption of polarised light by crystallized bodies. Under this head was related a curious fact, which may be of use to lapidaries. Heat does not, as is commonly supposed, produce the pink colour of some topazes, but merely discharges the yellowish colouring matter of one medium, and leaves the pink colouring matter which originally existed in the other. If, therefore, a pink colour exists in one of the images of a topaz seen by polarised light, the topaz will become pink on the application of heat.

It is not easy to give a complete abstract of a paper by simply hearing it read, especially when, like the present, it contains a great number of minute details. Dr. B., however, appeared to conclude from his experiments, that the colouring particles of crystals are not dispersed indiscriminately throughout their mass, as usually imagined; but are confined to different media, or rather that they possess an arrangement connected with the ordinary and extraordinary forces which they exert upon light.

Nov. 19—The Society met, but no paper was read, on account of the death of the Queen.

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[*] See *Annals of Philosophy*, xi. 63, 298: also the preceding page.

Article IX.

SCIENTIFIC INTELLIGENCE, AND NOTICES OF SUBJECTS CONNECTED WITH SCIENCE.

I. *Black Lead-mine in Glen Strath-Farrar, &c.*

Professor Jameson has examined the *Black Lead-mine* in Glen Strath-Farrar, 22 miles from Beauly, in Inverness-shire, and finds the ore disposed in irregular but promising masses in gneiss. He also met with the cinnamon-stone in gneiss, near Kincardine, in Ross-shire; and in the same district crystals of *apatite* imbedded in quartz veins that traverse gneiss. In Ross-shire, Professor Jameson saw that particular variety of granite found in Corsica, and which has been so much noticed by French geologists under the name of *orbicular* or Corsican granite: and near Drimnadrochit, in Inverness-shire, he observed that rare mineral the anthophyllite.

II. *Ranges of Hills of Iron Ore in Brazil.*

Mr. Engineer Von Eschwege, Director of the Mines of Minas Geraes in Brazil, informs us that the abundance of iron ore in Minas Geraes is extraordinary; and he questions if any other district on the face of the earth contains so much. The ores are magnetic iron stone, iron glance, iron mica, and compact clay iron stone; and these are disposed not in veins, or single beds, but form whole hills and ranges of hills.

III. *Chromate of Iron in the Feroe Islands.*

Specimens of chromate of iron have been brought to Edinburgh, said to have been found in the Feroe islands. We have examined the specimens; but suspect that they are not the production of Feroe. Probably some of our mineralogical correspondents may be able to inform us if there are any other rocks in the Feroe islands, besides those of the floetz or secondary class.

IV. *Account of some new Minerals.* By Henry Heuland, Esq.

(To Dr. Thomson.)

DEAR SIR, *London, Oct.* 8, 1818.

Finding in your last number of the *Annals* a short translation, being an extract from a notice by M. Cordier, of Paris, on some minerals which were named by Werner; and being assured that M. Cordier could not have been possessed of a characteristic specimen when he examined the helvin, I beg to say that its crystalline form is a regular tetrahedron, instead of an irregular octohedron. The helvin, which has been known here many years, is seldom seen in its primitive form, usually presenting the most simple modification—Haüy's epointé; its locality is the mine called Brother's Lorenz, in the vicinity of Schwarzenberg in the Saxon Erzgebirg; and Werner named it from the *Greek* ἥλιος, sun-yellow.

The albin is a variety of the apophyllite, and has been known in this country about three years. It is well understood here that some of the French savans feel a reluctance to own the apophyllite of Ferro as such, and class it with the mesotype.

M. Cordier takes notice of Werner's pelium. Werner named it peliom, from *πελιωμα*, bluish colour.

I have just received two minerals, one under the name of Skorodite, from Stamm Asser, near Schneeberg, in Saxony; the other, a tungstate of lead, from Zinnwalde, in Bohemia. Mr. Breithaupt, at Freyberg, calls the first skorodite, after *σκοροδων*, garlic, as before the blow-pipe it gives out that smell. When thoroughly heated, it leaves a reddish-brown globule, which attracts the needle. Judging from the external character, I should believe the skorodite sent to me to be a cupreous arseniate of iron.

The tungstate of lead, as to its exterior, greatly resembles the brown acicular phosphate of lead from Poullouen in Britany, and from Rheinbreitbach on the Rhine; but the crystalline form is different, representing very acute four-sided pyramids.

Crystallized zircon has been discovered last year on the zoisite, from Prickler Halt, at the Sau Alpe, in Carinthia.

I have the honour to be, dear Sir,
Your most obedient and humble servant,
HENRY HEULAND.

V. *Curious Discovery that Spiders feed upon Sulphate of Zinc.*

(To Dr. Thomson.)

SIR, *Cork, July* 17, 1818.

Should the following account be deemed worthy a place in your *Annals of Philosophy*, you will oblige me by inserting it. It is the substance of an essay read before the *Cork Society for promoting Knowledge*, at a late sitting.

I am, Sir, with due respect, your very obedient servant,
THOMAS HOLT, Secretary.

A few months since, having occasion for some sulphate of zinc, I proceeded to examine my collection of metallic salts, amongst which I expected to find what I required. I readily found the paper, in which the label informed me the sulphate of zinc had been, but was much surprised to find none in it. A considerable quantity of minute particles of a yellowish-brown substance were scattered through the paper, some adhering to it, and all held together by an extremely fine silky thread. On removing the various papers, and searching to the bottom of the box, I discovered a portion of the sulphate of zinc, enveloped in a heap of the powdery substance. When I took it up, a very large spider ran out of it, and hid himself amongst the papers. The salt, with the exception of a thin shell, had been completely eaten by the insect. Never having met with or heard of a parallel circumstance, I was induced to investigate more minutely, with a view to discover if I might not have been deceived. On recovering the spider I found it was of the species "*Aranea Scenica*." It had assumed a perfectly black colour; was, on being approached or disturbed, remarkably brisk in his motions; but at other times would drag his legs after him in a peculiarly sluggish manner. Having cleaned the box, I deposited the insect in it with a lump of nearly two ounces of sulphate of zinc. In about 10 weeks he had pierced this also, and as usual had produced a considerable portion of the powder. I then deposited other metallic salts, as sulphates of iron, lead, and copper, muriates of lead and mercury, and nitrates of copper and silver, with the sulphate of zinc in the box; but the spider did not leave the latter, nor did he touch either of the other salts, though I removed the sulphate of zinc for a time from the box. Being thus satisfied of the fact, I endeavoured to ascertain if the salt had undergone any chemical change in passing through the spider. I caused him to fast two days, then deposited him in a clean box with 200 gr. of sulphate of zinc; and when I perceived he had eaten nearly half of it, I carefully weighed the remainder with the powdery substance; it weighed 170 gr.: here was a loss of near 30 per cent. This, however, might be in part water. I, therefore, collected 60 gr. of the powder, on which I poured six ounces of boiling water. A considerable part remained undissolved, though frequently agitated, during two days. Ten drops of sulphuric acid were then added, and the whole was dissolved. It seems probable, therefore, that the sulphate of zinc had been deprived of part of its acid in passing through the spider.

The insect at this time seems perfectly healthy, having eaten nearly four ounces of the salt in about six months. X.

VI. *Query respecting the Decay of Iron Rails.*

(To Dr. Thomson.)

SIR, *London, Sept.* 12, 1818.

The decay of iron bars and rails at their bases, whether let into stone or cast-iron, cannot have escaped the attention of a numerous class of your readers as well as yourself. May I, therefore, beg the favour of you, or such of your readers as have considered the subject and had experience of the evil, whether any remedy or palliation has been yet discovered, and what such remedy or palliative is? It has been suggested to me, that gray paper wrapped round the end of the bar will have some effect. If so, powdered gray paper might be employed in the same way as lead, to fill up the holes into which the bars are inserted. Lead has no effect, nor wood, as far as I have observed. Query putty, roman cement, tallow, and manganese, &c.?

Your constant reader, W. D. S.

VII. *Query respecting Wronski.*

London, Aug. 17, 1818.

Allow me to inquire, through the medium of the Annals, whether any thing, and what, has been published in this country on the subject of Wronski's mathematical works; for I am anxious to know in what estimation he is held by our mathematicians.

I see from the newspapers that the Royal Academy of Sciences in Lisbon has noticed him. It is stated that, at the sitting of June 24, " M. Ve de Conto read an introduction to a memoir which had gained a prize relative to the programma of the academy upon the demonstration of rules given by Wronski for the general reduction of equations."

The works mentioned below are those I am acquainted with: whether he has published any more I do not know. I am, &c.

An Amateur.

Introduction à la Philosophie des Mathématiques et Technie de l'Algorithmie. Par Hoëné Wronski, ci-devant Officier Supérieur d'Artillerie au Service de Russie. A Paris, chez Courcier, 1811.

Refutation de la Theorie des Fonctions analytiques de La Grange. Par Hoëné Wronski. A Paris, chez Blankenstein, 1812.

Philosophie de l'Infini, contenant des Contreréflexions et des Réflexions sur la Métaphysique du calcul infinitésimal. Par Hoëné Wronski. A Paris, 1814.

Philosophie de la Technie, Seconde Section, contenant les Lois des Séries comme Préparation à la Réforme des Mathématiques. A Paris, 1817.

VIII. *Table for computing Heights by the Barometer.*

By Dr. Tiarks.

(To Dr. Thomson.)

SIR, *Montreal.*

I hope that the following table for computing heights from barometrical observations will not be unacceptable to many of the readers of your journal.

It is founded on the following formula of La Place:

$$\text{Height in metres} = 18393\ \left(1 + \frac{2\,(t + t')}{1000}\right) \log.\frac{b}{b'}\left(1 + \frac{\vartheta - \vartheta'}{5412}\right)$$

b, expressing the height of the barometer.

t ϑ, the temperature of the air and the barometer, or the degrees of the detached and attached thermometers, according to the centigrade scale at the lower station.

b', t', ϑ', the same at the upper station.

This formula, supposing the mètre to be 39·371 English inches, and expressing the temperature according to Fahrenheit's scale, will be as follows:

$$\text{Height in English feet} = \frac{6131 \times 39371 \times 836}{900000}\left(1 + \tfrac{1}{418}\left(\frac{t + t'}{2}\right)\right.$$

$$\left.\log.\frac{b}{b'}\left(1 + \frac{5\,(\vartheta - \vartheta')}{48708}\right) = \left[\frac{6131 \times 39371 \times 836}{900000}\left(1 + \tfrac{1}{418}\left(\frac{t + t'}{2}\right)\right)\right]\right.$$

$$\times \left[\log.\frac{b}{b'}, - 0{\cdot}000044584\ (\vartheta - \vartheta')\right].$$

In order to find the difference of height of the two stations, take the difference of the logarithms of the heights of the barometer at the two stations, using five decimal places. Multiply this difference by 100000, or consider the decimals of the fifth places as unities, and apply A to it, which is found by entering the table with the argument $(\vartheta - \vartheta')$, and which will be subtractive whenever the temperature of the barometer at the lower station is higher than that at the upper station, as is usually the case, and additive when the contrary takes place. Take the logarithm of the result, and add B to it (entering the table with the argument $\frac{t + t'}{2}$), and reject 10 in the index. The result will be the logarithm of the height in English feet.

ϑ, degrees of the attached thermometers at the lower stations, by Fahrenheit's scale.

ϑ', degrees of the attached thermometers at the upper stations.

t, degrees of the detached thermometers at the lower stations.

t', degrees of the detached thermometers at the upper stations.

Arg. for A: $\vartheta-\vartheta'$ B: $\frac{t+t'}{2}$	A −	B	$\vartheta-\vartheta'$ $\frac{t+t'}{2}$	A −	B	$\vartheta-\vartheta'$ $\frac{t+t'}{2}$	A −	B
0	0	9·74661	30	134	9·77871	60	268	9·80686
1	4	9·74865	31	138	9·77968	61	272	9·80777
2	9	9·75068	32	142	9·78065	62	276	9·80868
3	13	9·75172	33	147	9·78161	63	281	9·80958
4	18	9·75275	34	151	9·78257	64	285	9·81048
5	22	9·75377	35	156	9·78353	65	290	9·81138
6	27	9·75480	36	160	9·78449	66	294	9·81228
7	31	9·75583	37	165	9·78545	67	299	9·81318
8	36	9·75685	38	169	9·78640	68	303	9·81407
9	40	9·75786	39	174	9·78735	69	308	9·81496
10	45	9·75888	40	178	9·78830	70	312	9·81585
11	49	9·75989	41	183	9·78925	71	317	9·81674
12	54	9·76090	42	187	9·79019	72	321	9·81763
13	58	9·76191	43	192	9·79114	73	325	9·81852
14	62	9·76292	44	196	9·79208	74	330	9·81940
15	67	9·76393	45	201	9·79302	75	334	9·82028
16	71	9·76493	46	205	9·79395	76	339	9·82116
17	76	9·76593	47	210	9·79489	77	343	9·82204
18	80	9·76692	48	214	9·79582	78	348	9·82292
19	85	9·76792	49	218	9·79675	79	352	9·82379
20	89	9·76891	50	223	9·79768	80	357	9·82466
21	94	9·76990	51	227	9·79861	81	361	9·82554
22	98	9·77089	52	232	9·79953	82	366	9·82641
23	103	9·77187	53	236	9·80046	83	370	9·82727
24	107	9·77286	54	241	9·80137	84	375	9·82814
25	111	9·77384	55	245	9·80230	85	379	9·82900
26	116	9·77482	56	250	9·80321	86	383	9·82987
27	120	9·77579	57	254	9·80413	87	388	9·83073
28	125	9·77677	58	259	9·80504	88	392	9·83159
29	129	9·77774	59	263	9·80595	89	397	9·83244
30	134	9·77871	60	268	9·80686	90	401	9·83330

The result thus found is, perhaps, as accurate as in most cases the nature of the observations will allow it to be. La Plac however, has given a co-efficient depending on the latitude of the place. The correction of B thence resulting is contained in the following table.

Arg. Latitude of the Place.

Correction of B.			Correction of B.			Correction of B.		
Lat.	+	Lat.	Lat.	+	Lat.	Lat.	+	Lat.
0°	124	90°	16°	105	74°	32°	54	58°
1	123	89	17	102	73	33	50	57
2	123	88	18	100	72	34	46	56
3	123	87	19	97	71	35	42	55
4	122	86	20	95	70	36	38	54
5	122	85	21	92	69	37	34	53
6	121	84	22	89	68	38	30	52
7	120	83	23	86	67	39	26	51
8	119	82	24	83	66	40	21	50
9	118	81	25	79	65	41	17	49
10	116	80	26	76	64	43	13	48
11	115	79	27	73	63	4	9	47
12	113	78	28	69	62	44	4	46
13	111	77	29	65	61	45	0	45
14	109	76	30	62	60		—	
15	107	75	31	58	59			Lat.

This table is copied from Bodi's Fahrbuck for 1817, where Prof. Gauss has published barometrical tables of nearly the same form as the above.

Example.—Barometer, lower station .... 30·292
upper station .... 29·450
Thermometer attached, lower station . . . $2\frac{1}{2}$
upper station . . . $8\frac{1}{2}$
detached, the same.
Lat. 45° 30′.

$$\frac{t+t'}{2} = 5\tfrac{1}{2}$$

$$\vartheta - \vartheta' = 6$$

$$\begin{array}{lr}
\text{Log. } 30292 = & 3{\cdot}48133 \\
\text{Log. } 29{\cdot}45 = & 3{\cdot}46909 \\
\hline
 & 0{\cdot}01224 \\
\text{A} \quad = & -27 \\
\hline
 & 1197 \\
\text{Log. } 11{\cdot}97 = & 3{\cdot}07809 \\
\text{B} \quad = & 9{\cdot}75428 \\
\text{Cor. of B} & -2 \\
\hline
 & 2{\cdot}83235 = \text{log. } 679{\cdot}7 \text{ English feet.}
\end{array}$$

I remain, Sir, your obedient servant,

J. L. TIARKS.

IX. *On the supposed Meteorological Period of 18 Years.*

I recently met with the following passage in Lalande, which I copy out, as some of your readers may like to look at the authorities to which he refers. It is in the second volume of his Astronomy (1792) at pp. 196, sect. 1504.

"M. Toaldo trouve que la periode de 18 ans ramene aussi les années seches ou pluvieuses, chaudes ou froides. (Della vera Influenza degli Astri, Saggio Meteorologico, 1770 & 1781, p. 177; Saros Meteorologique, Journal de Physique, tom. xxi. p. 176.) Sur les autres Influences que les Anciens attribuoient à la Lune, voy. Riccioli (Almag. i. 185; ii. 533) et la Connoissance des Temps, 1765, p. 161."

It is not my intention to enter into the much disputed point of the moon's influence on the weather; but the very remarkable seasons of the present year induced me to look back to a meteorological journal for 1800, from which I found that the summer then, like the present, was remarkably warm and dry, no rain falling for above two months, from June to August. The crops, as must be the natural consequence of so long a drought, were very short; but in 1800, the rain came in the latter end of August; the autumn and seed-time were very fine, and the grass sprung up luxuriantly after the ground had recovered its moisture. It will be curious to look back to 1782 and 1764; but I have no books at hand to which I can refer for the quantities of rain which fell in the different months of those years.

Aug. 20, 1818. S.

X. *Register of the Weather at New Malton, in Yorkshire.*

May.—Mean pressure of barometer, 29·760; max. 30·40; min. 29·10; range, 1·30 in.; spaces described by the curve, 4·27 in.; number of changes, 11.—Mean temperature, 52·171°; max. 68°; min. 38°; range, 30°.—Amount of rain, 2·30 in. Wet days, 11. Prevailing winds, N. and E. N. 7; N.E. 6; E. 9; S.E. 2; S. 1; S.W. 2; W. 2; var. 2; brisk winds, 6.

June.—Mean pressure of barometer, 29·853; max. 30·37; min. 29·18; range, 1·19 in.; spaces described by the curve, 4·81 in.; number of changes, 11.—Mean temperature, 62·360°; max. 83°; min. 47°; range, 36°.—Amount of rain, 1·33 in. Wet days, 6. Prevailing wind, W. N.E. 4; E. 2: S.E. 1; S. 3; S.W. 9; W. 4; var. 4; brisk winds, 5; boisterous, 2.

July.—Mean pressure of barometer, 29·870; max. 30·26; min. 29·50; range, 0·76 in.; spaces described by the curve, 4·65 in.; number of changes, 12.—Mean temperature, 65·000°; max. 88°; min. 45°; range, 43°.—Amount of rain, 1·40 in. Wet days, 5. Winds, calm and variable. N. 6; N.E. 2; E. 1; S.E. 2; S. 3; S.W. 4: W. 6; N.W. 4; var. 3; brisk winds, 3.

August.—Mean pressure of barometer, 29·850; max. 30·15; min. 29·33; range, 0·82 in; spaces described by the curve, 3·42 in.; number of changes, 10.—Mean temperature, 59·258° max. 83°: min. 44°: range, 39°.—Amount of rain, 2·17 in total this year, 22·76 in. Wet days, 4. Prevailing wind, N. N. 13; N.E. 5; S.E. 2; S. 3; S.W. 2; W. 5; var. 1; brisk winds, 5.

May commenced with the same wet, cold, and changeable weather as marked the close of April, and which continued with little variation until the 17th, when the atmosphere became more settled; and there was a considerable increase both in the pressure and temperature. From this time to June 3, the sky was clear and brilliant, and the changes in the barometer and thermometer very trifling. On the 5th, the maximum of temperature indicated 80°; but in consequence of a heavy storm to the northward of this place, and much vivid lightning in the evening, the heat gradually decreased until the 11th, when the thermometer rose to 81°. About seven, p.m. another storm passed over to the N.E.; and the lightning was almost incessant from 11 p.m. to 2 a.m. (the 12th.) This day the temperature increased to 83°, with heavy thunder clouds in a south direction, which, in the evening, drew off to the westward; and in this quarter the lightning was observed from nine to half-past eleven, p.m. At midnight, the edge of the storm approached us, with a few loud electrical discharges and a little rain. Showers continued to fall at intervals until the 26th, when the period closed with the same features as the preceding one.

From July 8 to 14, the temperature kept gradually increasing. On the 15th, the thermometer again rose to 83°, and the following day to 85°. On the 19th, between one and two, p.m., we had a thunder-storm here, with very heavy rain; but so local that it did not extend two miles either in an E. N.E. or N. direction, though in the S.S.W. it was tremendous, and did considerable damage.* At the commencement of this storm, the thermometer stood at 81°; but, during its continuance, and for some time afterwards, it was no higher than 60°. The temperature again declined, and the pressure also, until the 23d, on which day the thermometer was at 80°, accompanied with strong gusts of wind: on the following day it rose to 88°, being the greatest degree of heat we have experienced here since July 13, 1808: and at this maximum it remained above three hours. The maximum of the 24th was 83°; and of the 26th, 81°. The wind on the 27th, having veered to the northward, above half an inch of rain fell (though the barometer kept rapidly rising all the time), and the temperature underwent a material change; the thermometer at two, p.m. being no higher than 58°; thus making a difference in the maximum of 23°; and during the 24 hours a difference of 15° in the means of the extremes. This month terminated with the mean elevation both as to pressure and temperature.

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* At Westow, a small village to the S.S.W. of this place, the hailstones, several of which measured nearly two inches in circumference, being accompanied with torrents of rain, destroyed two fields of turnips; the plants and soil to a great depth being completely washed away, and the corn in several others laid as flat as though a roller had been passed over it. Two sheep were killed by the lightning, and a number of poultry by the force of the hailstones. A great quantity of hay was taken up by a whirlwind, a short time before the storm commenced, and carried a considerable distance. At Langton, another village to the S.E. of Malton, and about two miles eastward of Westow, there was no rain, &c. during the day.

It is observable that not only the mean pressure, the spaces described, and the number of changes in the direction of the column for the first three months very nearly correspond; but also that the quantity of rain and wet days in two of them are also as nearly equal.

The temperature from Aug. 1 to 4 gradually increased. On the 5th, the thermometer indicated 83°; and the following day 80°; after which, to the close of the month, it continued low, with very little variation in the extremes. The range of the barometer until the 26th was also limited; and on several days it remained nearly stationary, particularly from the 14th to the 23d, the amount of its different variations being barely equal to $\frac{3}{10}$ths of an inch. On the 17th, we had a considerable fall of rain, accompanied with a strong N.E. wind, the quantity from one to five, p. m. and from four to seven, a.m. (the 18th) exceeding $1\frac{3}{4}$ inches. At Pickering, eight miles to the N. there was no rain, while at Scarborough, it fell in torrents nearly three hours.

Though thunder-clouds have frequently appeared, there has been no storm of electricity observed in this neighbourhood during the last month. J. S.

New Malton, Sept. 1, 1818.

XI. *Perquadrisulphate of Iron.*

In the *Annals of Philosophy*, vol. x. p. 100, I have given an account of two salts composed of sulphuric acid and peroxide of iron. The one an orange powder, composed of 2 atoms of peroxide of iron + 1 atom sulphuric acid: the other a red astringent salt, soluble in water, incrystallizable, and composed of 1 atom of peroxide of iron and 3 atoms of sulphuric acid. My attention was lately recalled to this subject by an ingenious surgeon in Glasgow, who brought me some small octahedral crystals of a white colour, which he had obtained by evaporating a solution of protosulphate of iron with an excess of acid repeatedly in a china cup. He had been able to obtain these crystals only once. All his other experiments to obtain them had failed of success. Hence he was disposed to ascribe the formation of the crystal to a particular state of the atmosphere with regard to moisture. They had precisely the form of alum crystals. The whole of them scarcely exceeded one gr. in weight; so that it was impossible to attempt an accurate analysis of them. I dissolved one of them in distilled water, added a little potash to the solution, and then applied heat. There was a precipitation of peroxide of iron which I separated by the filter. To the filtered liquid I added a solution of sal-ammoniac. A precipitate of alumina fell, which, as nearly as I could judge by the eye, was as copious as the previous precipitate of peroxide of iron from the same crystal. The salt then was not a simple persulphate of iron. It contained at least two bases. Whether potash or ammonia was present, I did not attempt to determine, as the quantity must have been too minute to be easily appreciated, even supposing it present. I made some trials to obtain a similar salt, by mixing together pertrisulphate of iron and alum, and pertrisulphate of iron and sulphate of alumina; but neither by spontaneous evaporation, nor by evaporating by the heat of a steam-bath, could I procure any similar octahedral crystals. Hitherto, therefore, the nature of this new salt remains a problem, which I have not been able to solve.

But I have hit upon a method of procuring another species of persulphate of iron, which crystallizes, and possesses some curious enough properties. My method of proceeding was this. I took a solution of protosulphate of iron, which had remained exposed to the action of the air for above a twelvemonth, and was of course almost changed to persulphate. To this solution I added a quantity of sulphuric acid, and then concentrated it upon a steam-bath till its bulk was reduced to less than one half of its original state. On setting it aside for 24 hours, a number of crystals of protosulphate of iron were deposited. The mother liquor, which had a very deep red colour, was poured off these crystals into a Wedgewood evaporating dish, and placed upon a steam-bath at a temperature of rather more than 150°. Here it remained for several days. On looking at it I was surprised to find the colour much lighter, and a deposit of small white, semi-transparent crystals at the bottom of the vessel. These crystals were small, and so much involved in each other that I could not make out their shape in a satisfactory manner, though several of them seemed to be four-sided prisms.

These crystals had an acid and astringent taste; when exposed to the air they slowly attracted moisture, and deliquesced. They were soluble in alcohol, and gave that liquid a yellow colour. When put into water they speedily separated into small, shining, white scales, which rendered the water milky; but they dissolved in that liquid very slowly unless assisted by heat. I put four gr. of the crystals into 200 gr. of water: 24 hours elapsed before the solution was complete. I then added 10 gr.: in 48 hours they were also dissolved: 10 gr. more were added; and they also took about 48 hours to dissolve completely.

The solution was at first colourless, but it became distinctly yellow when the quantity of salt dissolved was considerable.

When the water was evaporated, the salt was obtained unaltered in small crystals, or more easily in the state of a white crust.

I took 15 gr. of the crystals, dried at the temperature of 150°, and dissolved them in water. The peroxide of iron being precipitated by ammonia and separated by the filter, I saturated the liquid with nitric acid and precipitated the sulphuric acid by nitrate of barytes. By this mode of analysis I found that the weight of sulphuric acid in the salt was twice as great as that of the peroxide of iron. Now an atom of peroxide of iron weighs 10, and an atom of sulphuric acid 5. Hence it is evident that this salt is composed of four atoms of sulphuric acid united to one atom of peroxide of iron; or it is a *perquadrisulphate of iron*. The very slow solubility in water of a salt containing so much sulphuric acid is remarkable. It is curious, likewise, that no decomposition of it is effected either by water or alcohol. It is obvious from this, that the whole of the acid is united to the peroxide of iron by a considerable affinity.

XII. *Plasticity of Clay ascribed to the Presence of Water.*

The singular property of argillaceous substances, in which originate the occupations of the potter and porcelain manufacturer, that of forming a paste with water susceptible of being moulded to, and preserving any destined form, is usually ascribed to aluminous earth, but, in my opinion, very erroneously.

It is well known, I believe, that alumina, whether native or artificial, however minutely divided, does not possess the character above alluded to, while in an uncombined state; that it acquires it by solution in an acid and precipitation, and that if the precipitate be deprived of the water in it contained, it resumes its pristine intractability, if I may be allowed the expression.

Does it not seem, therefore, that this valuable peculiarity arises from the presence of *hydrate* of alumina in clays, &c.?

PHILO-CHEMICUS LONDINENSIS.

XIII. *Notice respecting the Discovery of Pearl Sinter.*

By Dr. Clarke.

An English traveller of St. John's College, Cambridge, Mr. Hastings Robinson, lately arrived in that University from his travels in Italy; bringing to the Professor of Mineralogy some fine specimens of the curious *hydrate of silica*, commonly called *pearl-sinter*, from *Professor Santi*, of *Pisa*; accompanied by a written statement of the manner in which this mineral was originally discovered by *Professor Santi*; who published an account of it in his Travels, under the name of *amiatiti*; and also of the reprehensible conduct of *Dr. W. Thomson*, of *Naples*, who claimed the discovery as his own, and gave the mineral the name of *fiorite*. We shall insert an extract from *Professor Santi's* letter to *Mr. Robinson*, in the original Italian: at the same time expressing a hope that as the only effectual method of doing justice to *Professor Santi*, his own name may be bestowed on the mineral; and that it may be henceforth called by no other name than *Santilite*.

Extract of a Letter from Prof. Santi, in Pisa, to Hastings Robinson.

"Allorche io faceva quei miei viaggi per la Toscana, a lei non ignoti, io trovai quei minerali fino allora non scoperti da altri, e li descrissi nei ragguagli pubblicati dei miei viaggi, prima col nome descrittivo di stallattiti silicee, poi con quello di *amatiti*, dal nome della bella e gran montagna già volcanica detta il Montamiata. Il Prof. William Thomson di Oxford vidde nelle mie mani le amiatiti, seppe da me il luogo, ove io le aveva trovate, se ne provvidde, e le communico subito alla Soc. Reale di Londra, e all' Academia delle Scienze di Parigi, dando ad esse il nome improprio di *fioriti*, da quello di un piccolo castello non vicino. In questa maniera egli (forse senza volerlo) si usurpo' il piccolo pregio di quella scoperta, senza nominarmi. Io non gli feci guerra, ma cessai allora di aver con esso quella corrispondenza, che passava fra noi. Se queste quisquilie non le sembrano degne della sua dotta attenzione, forse esse potrebbero non dispiacere al Sig. Clarke, egregio Professore di Mineralogia nell' Universitá di Cambridge, ed a lei senza dubbio notissimo."

Pisa, Maggio 9, 1818.

XIV. *On the improper Mode of managing Dung-hills in England.*

By Mr. Dinsdale.

Oct. 3, 1818.

On reading the letters of your correspondent Mrs. Ibbetson, in the numbers of the *Annals* for April and August last, I could not help making a determination to trouble you myself on a branch of the same subject.

She has doubtless made similar observations to what I am about to offer, her experiments having embraced this peculiarly neglected part of agricultural chemistry.

I wish to draw the attention of your readers to the inconsistent practice of farmers in general (at least to my knowledge of the farmers of Lincoln, York, Essex, and Suffolk), with respect to manures, both in the making and application of them.

It is very common to see their men sweeping dry straw, chaff, and frequently the dressings of their gardens and orchards on to the dung-hills, which are mostly situated in a corner of their yards, sometimes walled in and sometimes not, but generally in an elevated situation, from which, as well as from their stables, cow-sheds, and piggeries, the liquid and most valuable part is suffered to drain away, not uncommonly forming a filthy drain, or stagnant pool, the exhalations from which cannot be healthy, either for themselves or cattle, and occupying what might be made an useful portion of their premises.

These heaps of dung and dry matter are, by numbers, suffered to lie until they are wanted for the land, perfectly undisturbed; *and even by* those who do turn them, they are seldom disturbed *more than twice*; consequently when they are carted to it, instead of being a well-rotted mass, they are, nine times out of ten, almost as far from this state as when thrown together; for even at the very bottom, it is common to find them half mouldy straw and dung from the stable, &c. In this state what they call manure is taken to the land, and, as if it required purifying from noxious qualities, is suffered to lay in small heaps before spreading, and perhaps some days longer before it is ploughed in; before which, the heat of the sun has evaporated what virtue had not drained off at home, and yet the farmer stares at the result.

I have pointed out these errors to more than one farmer in Lincolnshire; and they have found a very considerable saving indeed in manure by throwing the drainings of their stables, cow-sheds, piggeries, &c. back upon their dung-hills, and turning them more frequently. And especially where they have covered them up with sods or sward to keep in the vapours necessarily evolved during the process of decomposition; for I need not tell you that this method may form a principle more powerfully conducive to vegetation than all the boasted powers of muriate of soda.

The Chinese (who are said to surpass the whole world in making manures) keep their dung and other matter in vats or deep trenches well lined, and in a constantly liquid state; for which purpose, if they have not urine sufficient, water is thrown in, and in a similar though more liquid mixture, they steep the whole of their seed corn, not unfrequently throwing in a portion of nitrate of potash.

I shall close my letter by adding—without a proper attention to the processes of fermentation and putrefaction, and, as Mrs. Ibbetson justly observes, the adapting of the seed to the soil, agriculture never can arrive at any thing like perfection.

I am, &c. &c. W. M. Dinsdale.

XV. *Royal Geological Society of Cornwall.*

Fifth Annual Report of the Council, Oct. 1818.—On reviewing the history of the Society since the last anniversary, the Council is happy to be able to announce the increased and increasing prosperity of the Institution.

The extensive and elegant museum, which is now completed, and which is calculated to meet the necessities of an establishment of this kind in its state of perfection, cannot fail to have a happy influence on the fortunes of the Society. At the same time that it affords every convenience for the prosecution of the science of mineralogy and geology, it offers a secure, ample, and elegant depository for all kinds of valuable specimens, which the liberality and public spirit of its members may wish to see concentrated and preserved, for the good of science in general, and for the interests of this county in particular.

Muchgreater additions, as well of simple minerals as of geological specimens, have been made to the cabinet than during any former year; and it is particularly gratifying, as a proof of the great and increasing interest of the Institution with the public, that this augmentation arises entirely from private donations—the liberality of some of its members compensating the deficiencies which otherwise must have been produced by the present incompetency of the Society's funds. The principal contributors are J. H. Vivian, Esq. W. Maclure, Esq. A. Majendie, Esq. J. Paynter, Esq. Dr. Forbes, and the Rev. J. Rogers.

In communicating this very gratifying information, the Council cannot avoid expressing their regret that so few new specimens have been obtained from the county mines; and that consequently the department of the cabinet set apart for the reception of indigenous ores, which ought to be particularly rich and splendid, continues to be defective, and is eclipsed by many other collections, as well public as private—a circumstance uniformly exciting the surprise of strangers.

Considerable accession of information respecting the geological structure of the county has been obtained, which, although not very extensive, is valuable from its accuracy; and as it furnishes plans which may be successfully extended to other districts. The chief contributors in this way are Mr. Joseph Carne, the Rev. J. Rogers, and Dr. Forbes.

The Council earnestly request the attention of members to this—the grand object of the Institution. It is impossible for a few members to undertake the investigation of the whole county. It is, therefore, hoped that with the view of enabling the Society to complete its long-promised, but still very defective geological map, members will, in their respective districts, endeavour to ascertain the nature and relations of the rocks, and transmit their observations made, and specimens collected, from time to time, to the Secretary, who will be very ready to assist their inquiries by any advice or information in his power. Any person, even although unacquainted with the principles of geological science, can, it is obvious, collect specimens of the various rocks in his vicinity: and members are requested to bear this in mind, with the assurance that collections of this kind, with the various *localities* of the specimens affixed, will very materially promote the important object in view. One grand *desideratum*, and which might be very easily supplied by members resident in the different parts of the county, is to ascertain the exact limits of the different Granite and Killas districts. The farmers and miners, in any part of Cornwall, could give this information to any gentleman that would take the trouble to record it, or to trace the boundary lines on any of the county maps.

Owing to the great expenses necessarily incurred by the establishment of a new museum, &c. the funds of the Society cannot be said to be in the most flourishing state. It is however true, that chiefly through the liberal donations of some distinguished members, they are so far in a state of progressive improvement as to permit the Council to promise that before the next annual meeting all incumbrances will be cleared, and a balance left for promoting the various objects of the Institution.

The following papers have been read since the last report:

1. On the Literature of Cornish Geology. By John Forbes, M.D. Secretary.

2. An Account of Copper exported from, and imported into, Great Britain from 1796 to 1817 inclusive. Extracted from Parliamentary Records, and presented to the Society. By John Hearle Tremayne, Esq. M.P. Member of the Society.

3. On the Advantages to be derived from the Study of Natural History. By Dr. Forbes.

4. On Floors of Tin. By John Hawkins, Esq. F.R.S. M.G.S. Honorary Member of the Society.

5. On the various Relations of the Veins of Cornwall to each other, and to the containing Rocks; with the View of ascertaining their relative Ages. By Joseph Carne, Esq. F.R.S. M.G.S. Member of the Society.

6. On the Nomenclature of Cornish Rocks. By John Hawkins, Esq. F.R.S. M.G.S. Honorary Member of the Society.

7. On the Discovery of Hydrargyllite. By Miss Hill.

8. On the Hornblende Formation of the Parish of Saint Clere. By the Rev. John Rogers, Member of the Society.

9. On the Knowledge and Commerce of Tin among ancient Nations. By the Rev. Samuel Greatheed.

10. On the Geology of the West of Cornwall. By Dr. Forbes.

11. On the supposed Intercourse of ancient Nations, particularly the Phœnicians, with the Natives of Great Britain. By Henry Boase, Esq. Treasurer of the Society.

12. On Stream-Works. By Henry Boase, Esq.

13. Notice of the Quantity of Tin raised in Cornwall in the year ending June 30, 1818. By Joseph Carne, Esq. F.R.S. M.G.S. &c.

14. An Account of the Produce of the Copper Mines of Cornwall in the Year ending June 30, 1818. By Joseph Carne, Esq. F.R.S. &c.

15. An Account of Copper produced in Great Britain and Ireland in the Year ending June 30, 1818. By Joseph Carne, Esq. F.R.S. &c.

16. Notice on the Geology of the Isle of Wight, in Reference to a Set of Specimens. By R. G. Kirkpatrick, Esq.

At the Anniversary Meeting, Oct. 6, 1818, Davies Gilbert, Esq. M.P. F.R.S. President, in the Chair, the Report of the Council being read,

Resolved, that the thanks of the Society be presented,

1. To the authors of the various papers read; to the donors of specimens, respectively; and more especially to J. H. Vivian, Esq. to John Paynter, Esq. and Ashhurst Majendie, Esq. for their very liberal donations.

2. To Dr. Paris for his obliging and able supervision of the publication of the first volume of the Society's Transactions.

3. *To the officers of the Society*, respectively; and, in a par-

ticular manner, to the Curator for his great attention to the interests of the Society, and for his excellent arrangement of the mineralogical cabinet.

4. To the agents of the Gwallan Mine for their donation of elvans.

5. To Mr. Richard Moyle, Assistant-Secretary, for his valuable map, plans, and drawings, illustrative of the geology of western Cornwall; and to Mr. W. Teague, Jun. for his plan and sections of Huel Peever and Treskirby Mines.

Resolved—That tamping bars be made in Penzance, on the plan recommended by Mr. Chenhalls, under the inspection of the Secretary; that he be requested to cause to be printed, on cheap paper, such an accurate description of the manner of making and repairing them as will enable any common blacksmith to manufacture them therefrom; that these papers be transmitted to the agents of all the great mines in the county, and also to the minister of every parish.

Comparative View of the Number of Members.—Last anniversary, 166; removed and dead, 12; elected this year, 18; total, 172.

Officers and Council for the present Year.—*President*; Davies Gilbert, Esq. M.P. F.R.S. &c. &c.

Vice-Presidents.—Sir C. Hawkins, Bart.; F. H. Rodd, Esq.; W. Rashleigh, Esq.; Rev. John Rogers.

Secretary.—John Forbes, M.D.

Treasurer.—Henry Boase, Esq.

Librarian.—Rev. C. V. Le Grice, A.M.

Curator.—Edward C. Giddy, Esq.

Assistant-Secretary.—R. Moyle, Jun. Esq.

The Council.—Joseph Carne, Esq.; L. C. Daubuz, Esq.; Stephen Davey, Esq.; R. W. Fox, Jun. Esq.; H. M. Grylls, Esq.; W. R. Hill, Esq.; Rev. W. Hockin; Samuel John, Esq.; Capt. E. Scobell, R.N.; H. P. Tremenheere, Esq.

XVI. *Northern Expedition.*

A considerable number of animals and other objects of natural history have been brought home by the different ships composing the northern expedition. The animals consist chiefly of birds and zoophytes; some of which are new. We are promised an account of these for the next number.

XVII. *Serpentine.*

The serpentine is a rock possessed of well marked characters, so that it is easily recognized; yet the difference between various specimens is so great that one cannot help suspecting that it is either a mixture of different species, or at least that it very frequently contains foreign matter mixed with the genuine serpentine in such a way that the eye cannot distinguish between the pure stone and the mixture. This notion is further strengthened by comparing together the different analyses of this mineral which have been hitherto made. The following table exhibits all these analyses with which I am acquainted.

1. Common Serpentine.

Silica	32·00	45·00	44·0
Magnesia	37·24	33·50	44·0
Alumina	0·50	Trace	2·0
Lime	10·60	6·25	—
Oxide of iron	0·60	14·00	7·3
Oxide of manganese	—	—	1·5
Oxide of chromium	—	—	2·0
Volatile matter	14·16	—	—
Loss	4·90	1·25	—
	100·00[*]	100·00[†]	100·8[‡]

2. Precious serpentine.

Silica	42·50	43·07
Magnesia	38·63	40·37
Alumina	1·00	0·25
Lime	0·25	0·50
Oxide of iron	1·50	1·17
Oxide of manganese	0·62	—
Oxide of chromium	0·25	—
Water	15·20	12·45
Loss	0·05	2·19
	100·00[§]	100·00[‖]

Mr. Keferstein, of Halle, has recently published a description of a mineral, which he considers as a variety of serpentine, and distinguishes by the name of *white serpentine.* It occurs massive in different beds of serpentine. Its colour is white, often with a shade of green. Fracture, even and dull. Fragments indeterminate, and not particularly sharp-edged. Difficultly frangible. A fatty peel. Its constituents, as determined by the analysis of Bucholz, are as follows:

Silica	$45\frac{2}{5}$
Magnesia	$35\frac{53}{112}$
Oxide of iron	$2\frac{2}{3}$
Alumina	$1\frac{7}{8}$
Lime	$0\frac{87}{112}$
Water	14
	$100\frac{161}{840}$

So that it agrees very nearly in its constituents with common serpentine.—(Schweigger's Jour. xxi. 134.)

---

[*] Hisinger, from Norberg, in Sweden.

[†] Knoch, from the Hartz.

[‡] Vauquelin; from Liguria.

[§] John.

[‖] Hisinger, from Skyttmine, near Fahlun.

Article X.

Astronomical, Magnetical, and Meteorological Observations.

By Col. Beaufoy, F.R.S.

Bushey Heath, near Stanmore.

Latitude 51° 37′ 42″ North. Longitude West in time 1′ 20″.

Astronomical Observations.

Oct. 2.	Emersion of Jupiter's first satellite	6h 28′ 53″	Mean Time at Bushey.
		6 30 14	Mean Time at Greenwich.
13.	Beginning of lunar eclipse.	16 41 20	Mean Time at Bushey.
		16 42 41	Mean Time at Greenwich.

Magnetical Observations, 1818. — Variation West.

Month.	Morning Observ.		Noon Observ.		Evening Observ.	
	Hour.	Variation.	Hour.	Variation.	Hour.	Variation.
Oct. 1	8h 25′	24° 33′ 26″	1h 20′	24° 44′ 32″	Owing to the shortness of the days, evening observation discontinued.	
2	8 20	24 33 05	1 20	24 46 27		
3	8 35	24 37 31	1 25	24 46 24		
4	8 20	24 37 51	1 20	24 43 30		
5	8 20	24 35 58	1 25	24 45 30		
6	8 20	24 35 29	— —	— — —		
7	8 25	24 43 15	1 20	24 45 19		
8	8 20	24 34 47	1 20	24 43 22		
9	8 20	24 35 52	1 20	24 44 48		
10	8 25	24 34 13	1 25	24 43 39		
11	8 25	24 33 49	1 20	24 43 38		
12	8 20	24 34 23	1 25	24 42 43		
13	8 25	24 33 07	1 20	24 44 18		
14	8 25	24 35 12	1 20	24 45 48		
15	8 45	24 39 29	1 20	24 45 10		
16	8 25	24 32 55	1 20	24 44 55		
17	8 25	24 38 56	1 20	24 46 00		
18	8 25	24 33 50	1 20	24 43 42		
19	8 25	24 34 42	1 25	24 43 20		
20	8 30	24 35 48	1 20	24 42 49		
21	8 25	24 35 50	1 20	24 44 20		
22	8 25	24 35 16	1 15	24 44 15		
23	8 30	24 35 08	1 15	24 41 53		
24	8 25	24 38 11	1 20	24 42 04		
25	8 25	24 36 02	1 30	24 43 11		
26	8 25	24 34 50	1 15	24 41 33		
27	8 25	24 35 20	1 20	24 40 47		
28	8 30	24 35 09	1 25	24 40 42		
29	— —	— — —	— —	— — —		
30	8 30	24 34 27	1 25	24 45 48		
31	8 25	24 34 04	1 30	24 54 26		
Mean for Month.	8 25	24 35 36	1 20	24 43 28		

In taking the mean of the noon observations, that on the 31st *is not* included, being so much in excess. The weather between the morning and noon observations was rainy; and at the time of the noon observation, Bushey Heath was enveloped in a cloud.

Meteorological Observations.

Month.	Time.	Barom.	Ther.	Hyg.	Wind.	Velocity.	Weather.	Six's.
Oct.		Inches.				Feet.		
1	Morn....	29·010	58°	73°	SE by E		Fine	51°
	Noon....	29·005	61	58	SSE	7·342	Showery	62
	Even....	—	—	—	—		—	51
2	Morn....	29·150	55	68	SE		Very fine	
	Noon....	29·187	63	45	Var.	4·421	Very fine	63½
	Even....	—	—	—	—		—	53½
3	Morn....	29·110	58	92	S		Showery	
	Noon....	29·095	62	94	S by W	—	Showery	62
	Even....	—	—	—	—		—	52
4	Morn....	29·086	55	73	SW by S		Fine	
	Noon....	29·050	55	64	SW	—	Showery	60
	Even....	—	—	—	—		—	47
5	Morn....	28·978	52	58	W by S		Cloudy	
	Noon....	28·978	57	46	W	14·881	Show. thund.	57½
	Even....	—	—	—	—		—	40
6	Morn....	28·840	44	60	W		Very fine	
	Noon....	—	—	—	—	—	—	55
	Even....	—	—	—	—		—	42½
7	Morn....	29·089	44	73	NW		Foggy	
	Noon....	29·100	56	49	NW	3·447	Fine	55½
	Even....	—	—	—	—		—	42
8	Morn....	29·335	44	74	N		Foggy	
	Noon....	29·357	55	59	N	2·862	Very fine	56
	Even....	—	—	—	—		—	43
9	Morn....	29·420	48	66	W by S		Cloudy	
	Noon....	29·390	56	50	W by S	—	Cloudy	57
	Even....	—	—	—	—		—	47½
10	Morn....	29·215	54	79	SW by S		Sm. rain	
	Noon....	29·187	59	77	SW by S	10·736	Sm. rain	59
	Even....	—	—	—	—		—	54½
11	Morn....	29·090	57	97	SW		Sm. rain	
	Noon....	29·090	60	70	SSW	—	Showery	59½
	Even....	—	—	—	—		—	46
12	Morn....	29·273	48	56	S by W		Clear	
	Noon....	29·333	57	43	SW	16·090	Fine	58
	Even....	—	—	—	—		—	46½
13	Morn....	29·405	51	79	S by W		Cloudy	
	Noon....	29·403	—	55	SSW	—	Showery	61½
	Even....	—	—	—	—		—	51½
14	Morn....	29·552	55	82	S by W		Foggy	
	Noon....	29·537	65	45	SSE	—	Very fine	65
	Even....	—	—	—	—		—	54
15	Morn....	29·500	57	78	SE		Rain	
	Noon....	29·495	62	56	SSE	—	Cloudy	64
	Even....	—	—	—	—		—	55½
16	Morn....	29·526	57	69	S by W		Cloudy	
	Noon....	29·550	63	63	SSW	—	Showery	64
	Even	—	—	—	—		—	54½
17	Morn....	29·647	58	77	NE		Fine	
	Noon....	29·630	65	56	E	—	Fine	65½
	Even....	—	—	—	—		—	51½
18	Morn....	29·500	52	87	E		Fine	
	Noon....	29·489	59	60	SSW	—	Cloudy	60½
	Even....	—	—	—	—		—	

Meteorological Observations continued.

Month.	Time.	Barom.	Ther.	Hyg.	Wind.	Velocity.	Weather.	Six's.
Oct.		Inches.				Feet.		
	Morn....	29·540	52°	78°	Calm		Cloudy	50°
19	Noon....	29·530	56	69	SSE	—	Cloudy	56½
	Even....	—	—	—	—		—	51
	Morn....	29·608	52	61	SE by E		Cloudy	
20	Noon....	29·625	58	49	E by S	—	Fine	60
	Even....	—	—	—	—		—	44
	Morn....	29·730	47	51	E		Clear	
21	Noon....	29·690	54	45	E	—	Very fine	54½
	Even....	—	—	—	—		—	47
	Morn....	29·550	48	60	ESE		Very fine	
22	Noon....	29·526	52	54	ESE	—	Cloudy	53½
	Even....	—	—	—	—		—	43
	Morn....	29·522	48	70	ESE		Cloudy	
23	Noon....	29·535	51	56	E	—	Cloudy	52½
	Even....	—	—	—	—		—	45
	Morn....	29·600	45	56	E		Cloudy	
24	Noon....	29·600	47	55	E by N	—	Cloudy	49
	Even....	—	—	—	—		—	45
	Morn....	29·588	49	77	E by N		Scud	
25	Noon....	29·587	54	57	E by S	—	Very fine	57½
	Even....	—	—	—	—		—	49
	Morn....	29·609	51	60	ESE		Fine	
26	Noon....	29·623	60	49	E by S	—	Fine	61
	Even....	—	—	—	—		—	50
	Morn....	29·686	52	56	E by S		Very fine	
27	Noon....	29·700	61	41	SSE	—	Very fine	61
	Even....	—	—	—	—		—	50
	Morn....	29·700	53	69	SW by S		Very fine	
28	Noon....	29·713	61	56	WSW	—	Cloudy	60½
	Even....	—	—	—	—		—	51
	Morn....	29·825	—	—	Calm		Misty	
29	Noon....	—	—	—	—	—	—	58
	Even....	—	—	—	—		—	49
	Morn....	29·864	52	53	Calm		Fine	
30	Noon....	29·820	56	48	SW	—	Cloudy	57
	Even....	—	—	—	—		—	51
	Morn....	29·615	51	79	SSW		Sm. rain	
31	Noon....	29·520	55	83	SW	—	Cloudy	56½
	Even....	—	—	—	—		—	

Rain, by the pluviameter, between noon the 1st of Oct. and noon the 1st of Nov. 1·384 inches. Evaporation, during the same period, 1·97 inches.

ARTICLE XI.

METEOROLOGICAL TABLE.

1818.	Wind.	Barometer.			Thermometer.			Hygr. at 9 a. m.	Rain.	
		Max.	Min.	Med.	Max.	Min.	Med.			
10th Mon.										
Oct. 22	SE	30·00	29·93	29·965	55	41	48·0	68		☽
23	E	30·07	30·00	30·035	55	45	50·0	71		
24	NE	30·07	30·02	30·045	55	44	49·5	70	13	
25	SE	30·05	30·01	30·030	60	46	53·0	73		
26	SE	30·15	30·05	30·100	62	36	49·0	70		
27	SE	30·16	30·14	30·150	60	37	48·5	72		
28	SW	30·30	30·16	30·230	65	44	54·5	75		
29	SW	30·35	30·30	30·325	60	41	50·5	79		○
30	SW	30·30	30·05	30·175	58	43	50·5	72		
31	SW	30·05	29·89	29·970	57	46	51·5	81	20	
11th Mon.										
Nov. 1	NW	29·93	29·87	29·900	58	45	51·5	75		
2	SW	29·87	29·70	29·785	60	51	55·5	77	2	
3	SW	29·70	29·45	29·575	61	42	51·5	74		
4	SE	29·45	29·35	29·400	56	48	52·0	79	8	
5	NE	29·35	29·24	29·295	60	52	56·0	82	1	☾
6	E	29·60	29·26	29·430	58	50	54·0	77		
7	SE	29·87	29·60	29·735	51	35	43·0	75	3	
8	E	29·94	29·87	29·905	52	42	47·0	78		
9	NE	29·98	29·95	29·965	52	44	48·0	81		
10	NE	29·95	29·72	29·835	50	45	47·5	79	86	
11	SE	29·80	29·65	29·725	53	41	47·0	99	3	
12	SE	29·65	29·53	29·590	50	41	45·5	80	6	●
13	SE	29·60	29·55	29·575	57	46	51·5	94	2	
14	S	29·55	29·32	29·435	56	43	49·5	77	52	
15	W	29·71	29·45	29·580	57	41	49·0	72	—	
16	SW	29·70	29·44	29·570	52	41	46·5	96	43	
17	W	30·05	29·70	29·875	47	31	39·0	71		
18	SW	30·07	30·05	30·060	47	34	40·5	90		
19	SE	30·07	29·90	29·985	50	35	42·5	89		
20	SE	29·90	29·70	29·800	45	36	40·5	76		
		30·35	29·24	29·834	65	31	48·75	78	2·39	

The observations in each line of the table apply to a period of twenty-four hours, beginning at 9 A. M. on the day indicated in the first column. A dash denotes, that the result is included in the next following observation.

REMARKS.

Tenth Month.—23. Windy. 24. Cold wind: some rain, evening. 29, a. m. misty.

Eleventh Month.—1. Foggy morning. 6. Foggy evening. 7. Very fine, a. m. 10. Much wind, with heavy rain, in the night: about 10, p. m. the clouds were passing over rapidly from SE. 11. Small rain, a. m.: gloomy, p. m. 12. The moon at night rose gold coloured, and slightly veiled at intervals by the lighter modifications, with a mixture of haze: on these clouds were afterwards displayed a succession of halos, strongly coloured with green and red. I found by attentive observation that the halo in this instance, together with a corona, which appeared constantly within it, was not formed in the substance of the clouds above-mentioned, but in the haze, which was probably situated near the earth; for the colours of the halo always survived (though faintly) the passing away of the white skreens of cloud by which at intervals they were set off and made conspicuous. 13. A fine day: large *Cumuli* beneath *Cirri*, the latter ranging at night from SE to NW very conspicuously: the moon again rose gold-coloured. 14. Rain, a. m.: and again in the fore part of the night, with much wind from the southward. 15. Windy, cloudy, a. m.: lunar halo: rain in the night. 16. Wet morning: fair, p. m., with *Cirrus*, *Cirrostratus*, and *Cumulus*. 17—20. Fair: the sensible evaporation somewhat reinstated, with a brisk wind at the close.

RESULTS.

Prevailing Winds Southerly and Easterly.

Barometer:	Greatest height	30·35 inches.
	Least	29·24
	Mean of the period	29·884
Thermometer:	Greatest height	65°
	Least	31
	Mean of the period	48·15
Mean of the Hygrometer		78
Evaporation		1·31 inches.
Rain		2·29 inches.

The observations on the thermometer and rain for the former half of the period, and on the hygrometer for the whole, were made at the laboratory.

N.B. On the 26th of tenth month, a little before eight in the evening, I observed from the neighbourhood of Lowestoft, Suffolk, a distinct commencement of *Aurora Borealis* in the north, in white streamers ascending to a considerable elevation, which after a minute or two became converted into a still light: the latter, remaining for an hour or two after, was at length obscured by clouds.

Tottenham, *Eleventh Month*, 24, 1818. L. HOWARD.

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